WIRELESS ENGINEER

THE JOURNAL OF RADIO RESEARCH & PROGRESS

DECEMBER 1956

Vol. 33 No. 12 · THREE SHILLINGS AND SIXPENCE

WIDE BAND
SIGNAL GENERATOR
Type T.F.M.

Regd Trade Mark

The design of this new Wide Band Signal Generator, **operating throughout on fundamentals**, is the outcome of considerable research and development work to meet the stringent requirements imposed by new frequency modulation and commercial television stations.

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Facilities are provided to ensure adequate discrimination throughout the very wide frequency band covered by the instrument.

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The instrument is fitted with an R.F. carrier level meter.

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5-220 Mc/s in 8 ranges. CW or 400 c/s sine/square wave modulation. Accuracy ± 1%. Provision for spot frequency calibration.

FM COVERAGE

65-120 Mc/s. Accuracy ± 1%. Maximum deviation ± 150 Kc/s.

OUTPUT

Minimum (about 2μV) to 100 mV continuously variable with decade multiplier. Force output 250 mV.

OUTPUT IMPEDANCE

80Ω, 200Ω, balanced 80Ω and 300Ω, isolated unbalanced 80Ω.

OPERATING VOLTAGES

100-120V, 200-260V, 50-60 c/s A.C. mains.

LIST PRICE £89

DIMENSIONS

15¼ x 10½ x 10 in. approx. with lid closed.

WEIGHT: 16 lb. approx.

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Echo ranging	Computers
Radio navigation	Telemetering
Television	Physiological research

DESCRIPTION The Pulse, Sweep and Time-Delay Generator consists of the following major circuit groups: (1) input synchronizing circuits, (2) delay and coincidence circuits, (3) sweep circuits, and (4) pulse-timing and pulse-forming circuits.

3 INSTRUMENTS IN 1

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PULSE REPETITION RATE: 0-250 kc.
TIME DELAY: 1 μsec—1·1 sec.
DELAY REPETITION RATE: 0-400 kc.
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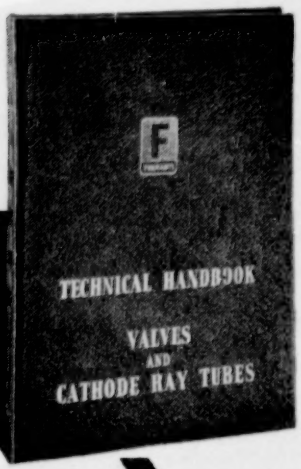

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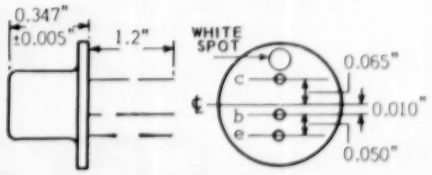

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SP88

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Nominal Current :	0.3	A
Mutual Conductance :	16.5	mA/V
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Output Capacitance :	2.9 ± 0.4	pF
Max. Direct Anode Voltage :	210	V
Max. Direct Anode Dissipation :	3.3	W
Max. Direct Screen Voltage :	175	V
Max. Direct Screen Dissipation :	0.9	W
Max. Direct Cathode Current :	25	mA

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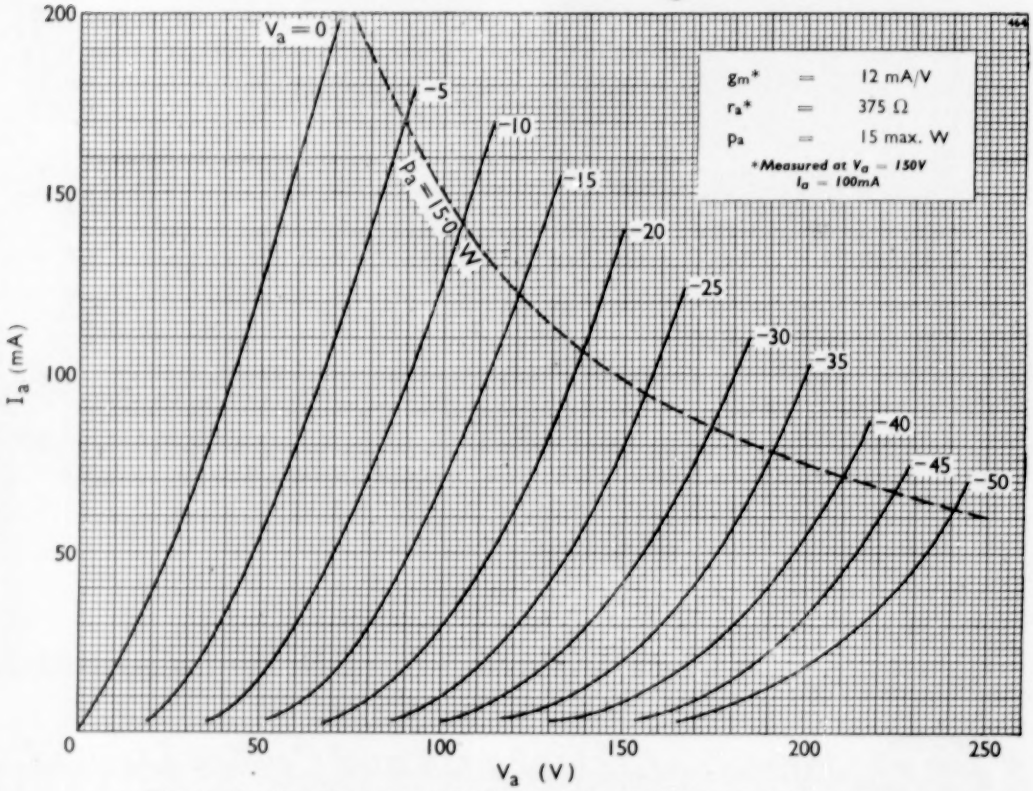
V_a	300 max.	V
I_a	120 max.	mA
Base	B9A	



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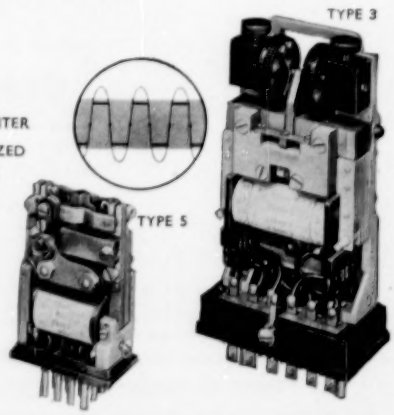

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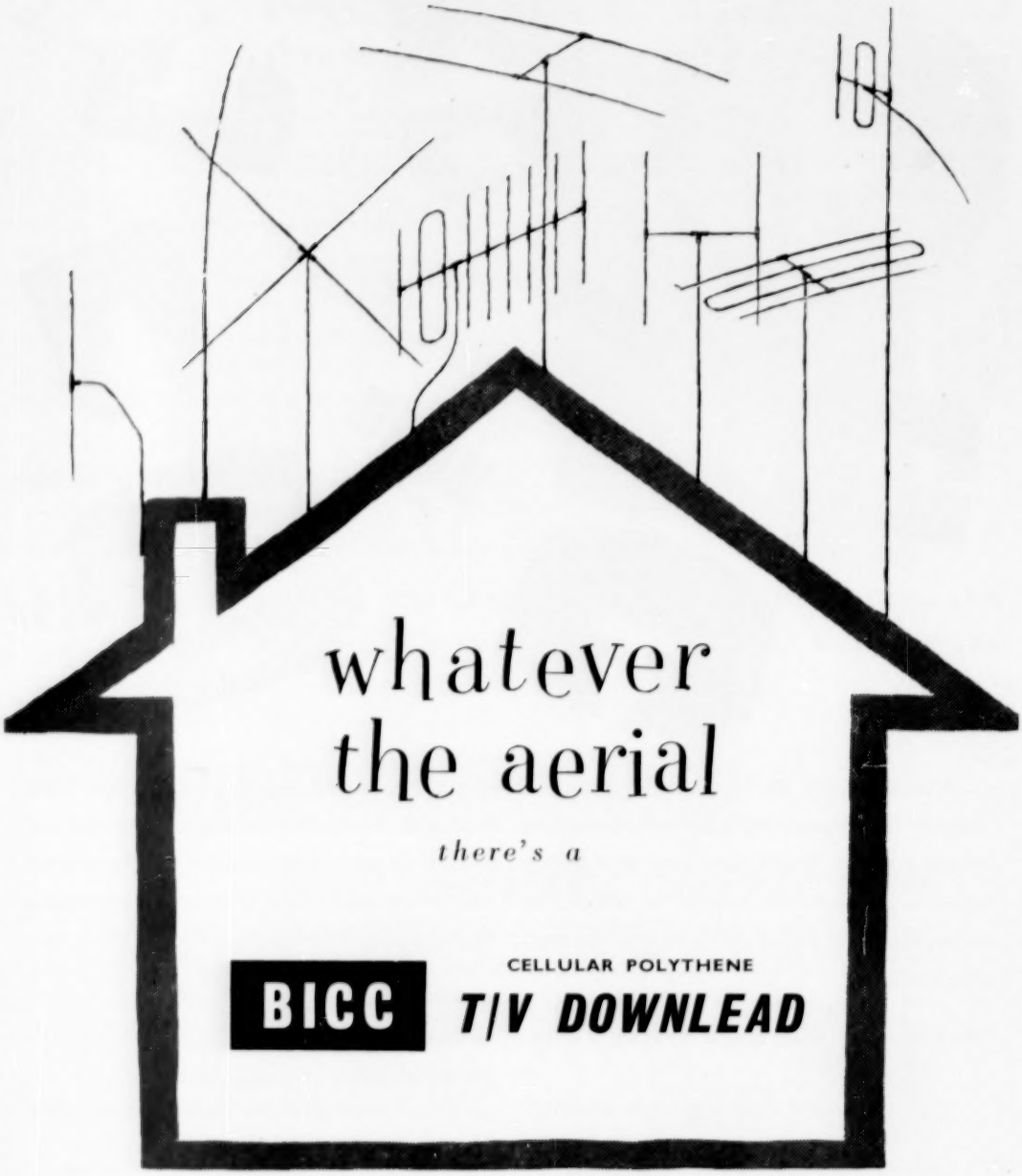

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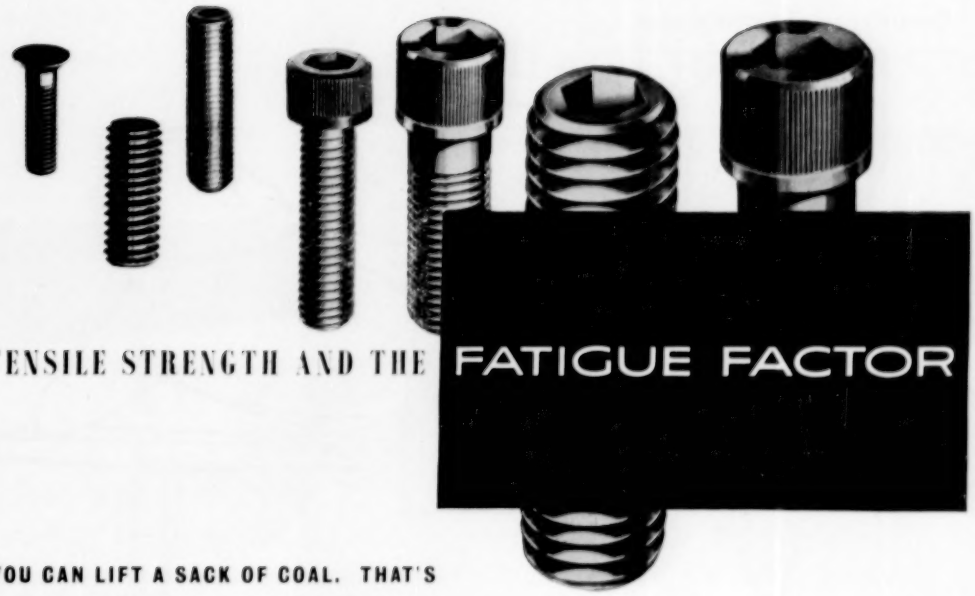

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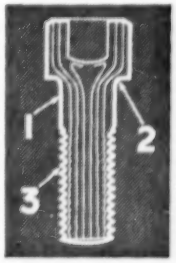

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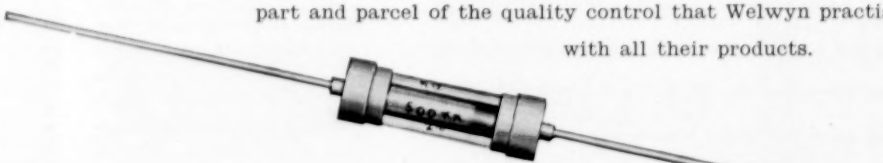

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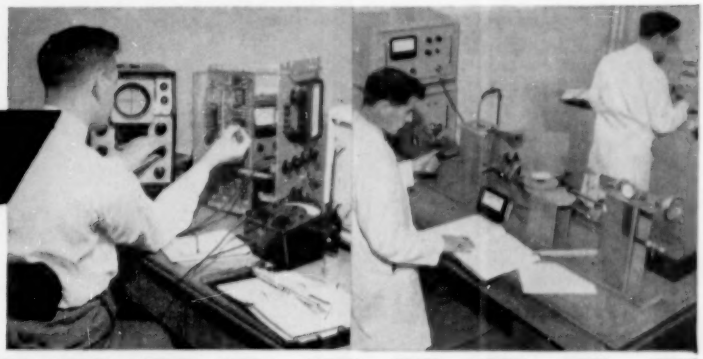

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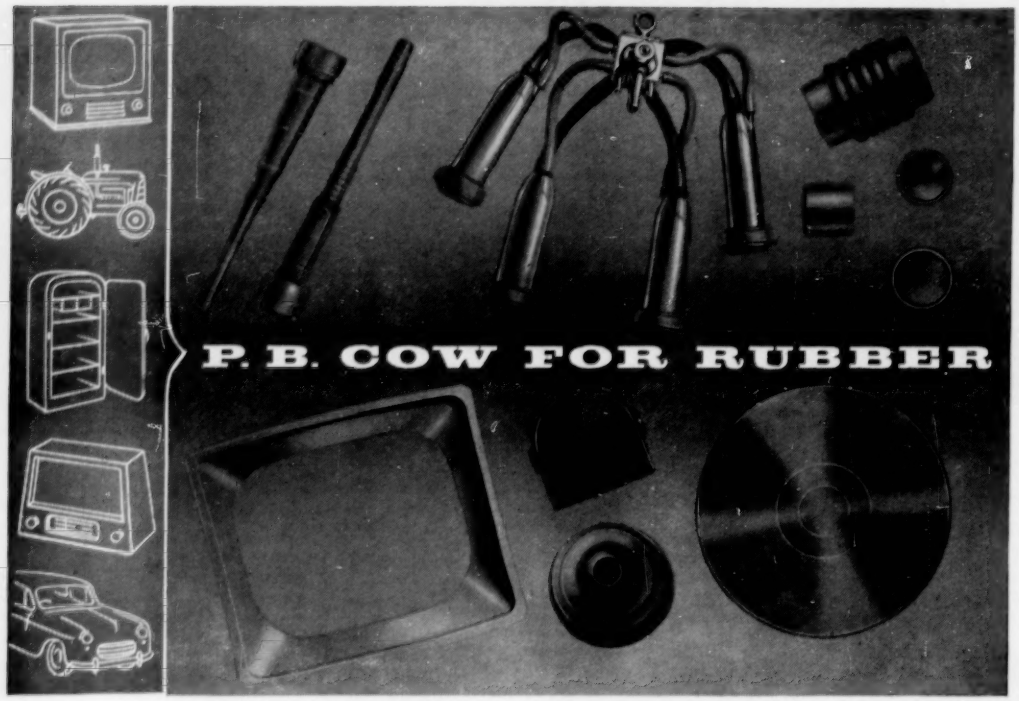

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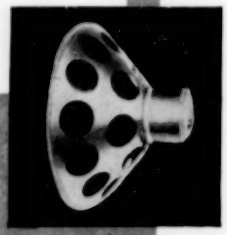

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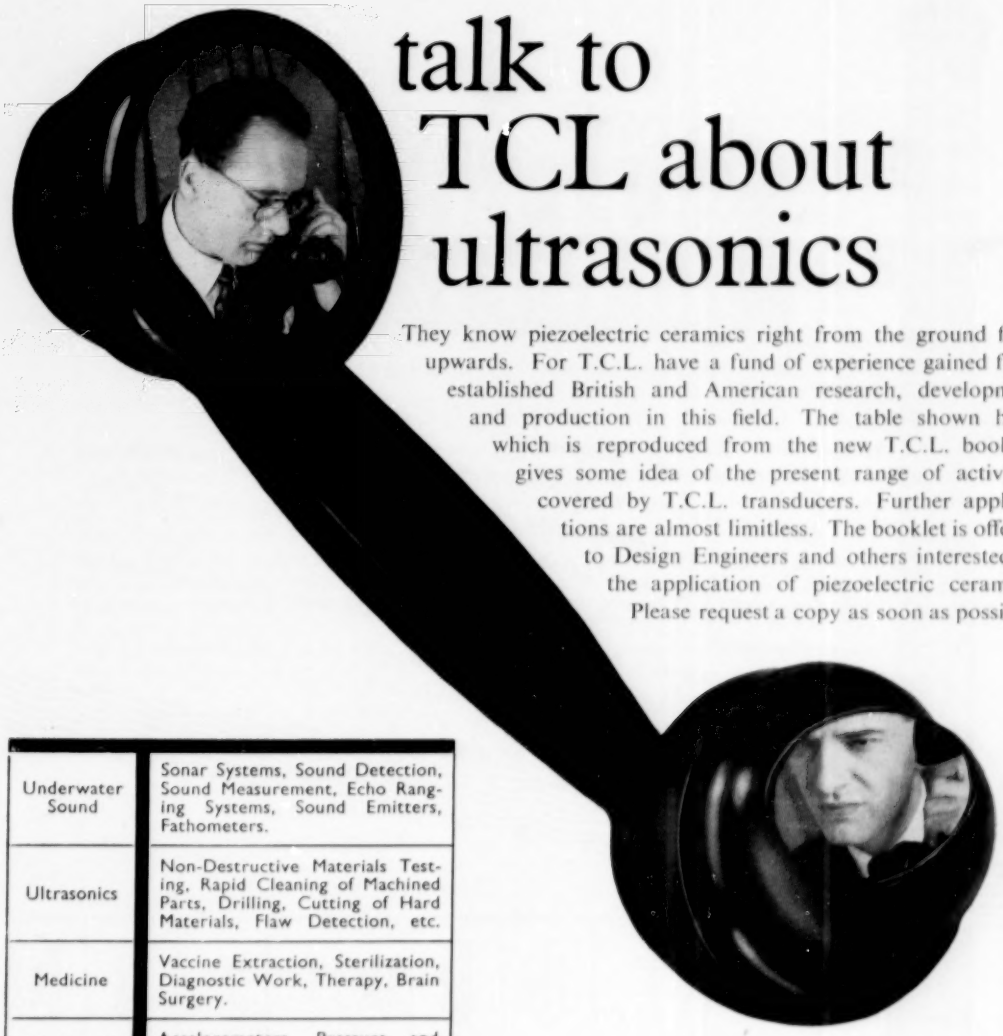

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N.1002	Low Noise	2000	1mW	10	24	550	200μA	200
N.1004	Power	4000	4W	–	21	2600	20mA	450
N.1005M	Low Noise	4000	1mW	11	22	360	200μA	350
N.1013	Voltage Amplifier	2000	200mW	20	32	650	4mA	300
N.1017M	Low Noise	1200	1mW	10	20	700	200μA	200
N.1018M	Voltage Amplifier	4000	100mW	20	30	630	2mA	350

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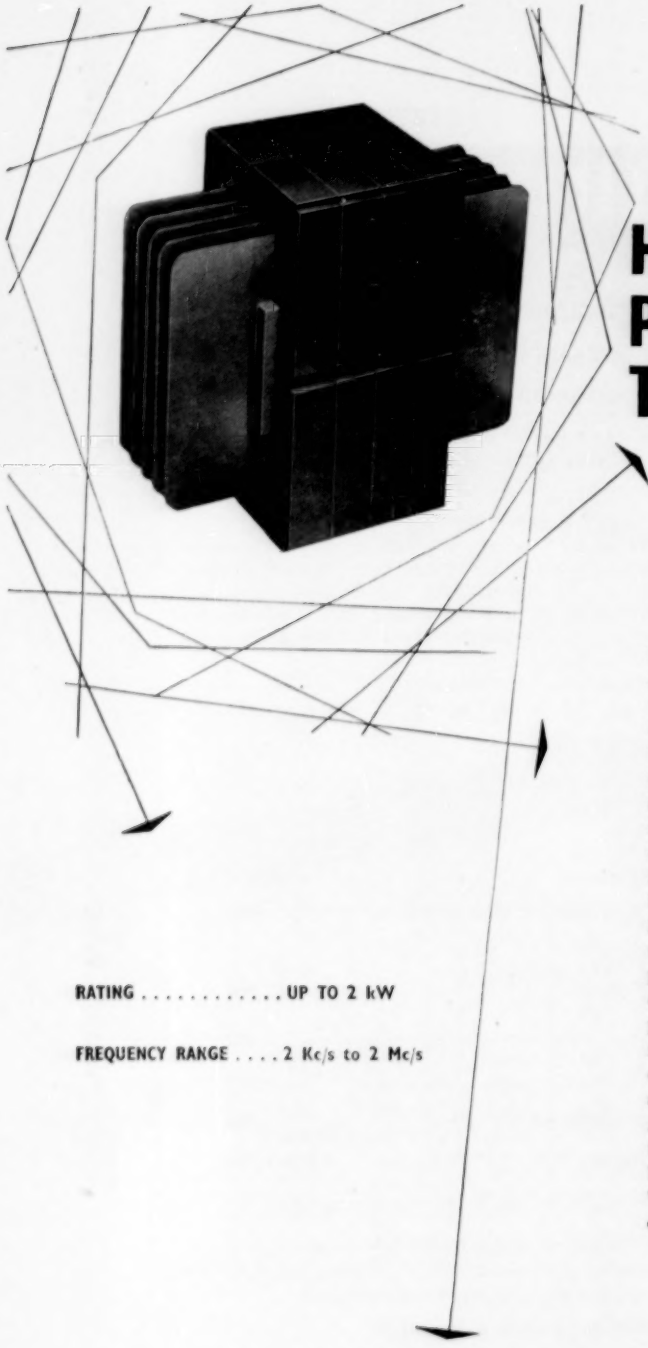

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FREE OSCILLATIONS IN SIMPLE DISTRIBUTED CIRCUITS

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SUMMARY.—The paper deals with the calculation of waveforms which occur when a progressive wave in a transmission line impinges on a terminating circuit. The method of calculation is used to determine the waveforms occurring in certain simple distributed circuits when in free oscillation.

1. Introduction

MUCH contemporary work involves the study and measurement of phenomena occurring in circuits containing distributed elements. It is clear that a knowledge of the behaviour of simple distributed circuits is a prerequisite for such work. The object of this paper is to outline the basic principles governing the behaviour of uniform transmission lines and to illustrate their application by the study of the behaviour of some distributed circuits when in free oscillation.

In the general sense, a distributed circuit may be taken to mean any circuit in which transit times cannot be neglected. In a lumped or point circuit an analysis can be carried out on the assumption that the effect of a voltage or current impressed in any branch of the circuit will be felt instantaneously in all other branches, without introducing errors greater than a required maximum. When this assumption introduces excessive errors, the transit times of the effects must be considered and the circuit is then regarded as being distributed. Aerial systems and transmission lines are examples of such circuits, but it will be realized that, under certain conditions, other circuit elements such as valves must be included.

In this paper, attention will be confined to the study of a linear passive distributed circuit consisting of a finite length of uniform transmission line terminated at each end by a simple point circuit. If such a network is driven at some point by a sinusoidal source, the voltage and current everywhere are sinusoidal and can be readily reproduced at any point by substituting an appropriate lumped circuit. This similarity in behaviour of lumped and distributed circuits when in forced sinusoidal oscillation is due simply to the property of sinusoids that the sum of any number of sinusoids of the same frequency is sinusoidal, regardless of the phase relations of component waves. If the driving waveform is other than sinusoidal no such correspondence in behaviour results.

The fundamental differences between lumped and distributed circuits are well illustrated by considering free oscillations in the systems. As is well known, a simple lossless lumped circuit of inductance and capacitance, when in free oscillation, produces sinusoidal voltage and current waveforms, independently of how the energy was initially stored in the circuit. A corresponding form of simple lossless distributed circuit when in free oscillation produces more complicated waveforms dependent on the manner of storage of energy initially. The calculation of waveforms in such a circuit is the basic problem considered, but the method used is applicable to more complicated circuits.

Attention is given to two basic forms of distributed circuit, to be referred to as circuits A and B. These are:

Circuit A: A uniform lossless transmission line with a pure inductance at one end and an open-circuit at the other.

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Circuit B: A uniform lossless transmission line with a pure capacitance at one end and a short-circuit at the other.

As the behaviour of the circuits is affected by the manner of storage of the energy initially, a further distinction will be made as follows:—

Case I: Energy initially stored in the lumped-circuit component (i.e., inductance for circuit A and capacitance for circuit B).

Case II: Energy initially stored in the distributed-circuit element (i.e., the transmission line).

Finally, the effect of circuit losses introduced by the insertion of resistances will be given for certain simple cases. The extension of the method of analysis to deal with more complicated circuits is discussed briefly.

Before proceeding to the first analysis a brief résumé of the properties of transmission lines relevant to the problems considered will be given.

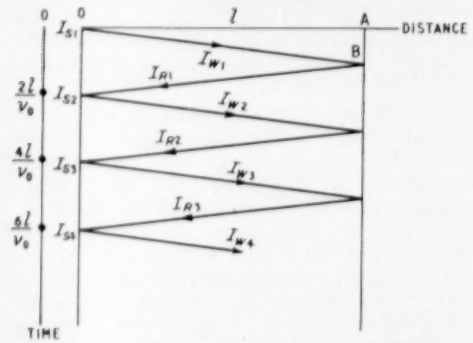


Fig. 1. *Diagrammatic representation of transmission line. The left-hand side is taken as the origin and I_W, I_R indicate successive reflections.*

2. Some Properties of Uniform Transmission Lines

2.1. *Nomenclature*

The nomenclature adopted in the following notes and analyses can be explained with the help of Fig. 1. The left-hand end of the line, where the inductance or capacitance is situated, is taken as the origin; the line extends for its length OA $= l$ in the direction of the x axis. The negative ordinate of the graph is time.

The oscillation is initiated at the origin at time zero and a current I_{S1} is produced in the termination. At the same moment a progressive current wave I_{W1} leaves O and travels with a finite velocity v_0 towards the right-hand termination. The progress of the wave is represented in Fig. 1 by the line OB. This first wave reaches the right-hand termination at time l/v_0, and a current wave I_{T1} is then set up in the termination. At the same time, a reflected current wave I_{R1} travels back towards the left-hand termination, which it reaches at time $2l/v_0$. As a result of the arrival of this reflected wave, a further current wave I_{S2} is set up in the termination and a re-reflected wave, called the second progressive wave I_{W2}, starts down the line.

The process is cyclic, and in a lossless circuit is repeated endlessly. In general terms I_{Sn} is the nth current wave in the left-hand termination from which I_{Wn}, the nth progressive wave, is derived. I_{Tn} is the current in the right-hand termination due to I_{Wn}, while I_{Rn} is the resulting current reflection, which sets up the I_{Sn+1} wave on reaching the left-hand end of the line. The voltage wave corresponding to any given current wave is indicated by replacing I by V.

Applying Kirchhoff's law to the terminations, it follows that the following relationships are true:—

$$\left.\begin{array}{ll} I_{W1} = I_{S1}^{*} & I_{R1} = I_{T1} - I_{W1} \\ I_{W2} = I_{S2} - I_{R1} & I_{R2} = I_{T2} - I_{W2} \text{ etc.} \end{array}\right\} \quad (1)$$

and in general

$$I_{Wn} = I_{Sn} - I_{Rn-1} \quad I_{Rn} = I_{Tn} - I_{Wn}$$

The convention adopted in this paper is that current circulating in a clockwise direction is taken as positive; voltage increasing in the same direction is taken as positive.

2.2. *Progressive Waves*

A uniform lossless transmission line is characterized by distributed inductance, L_0 henrys/metre, and distributed capacitance, C_0 farads/metre. Energy can be transmitted along the line in either direction at a finite velocity v_0 metres/second given by the equation

$$v_0 = \frac{1}{\sqrt{L_0 C_0}} \dagger \quad .. \quad .. \quad .. \quad .. \quad (2)$$

Energy is transmitted along the line in magnetic and electrostatic fields produced by a progressive current and voltage wave. At any instant in a progressive wave the current and voltage waveforms along the line are linearly related by the equation

$$\left.\begin{array}{l} V = Z_0 I \\ \text{where} \quad Z_0 = \pm\sqrt{\dfrac{L_0}{C_0}} \text{ ohms}\dagger \end{array}\right\} \quad .. \quad .. \quad (3)$$

is called the characteristic impedance of the line and is a pure resistance.

The two signs attributable to Z_0 refer to the reversible nature of the flow of energy. In this paper, a progressive wave travelling from left to right is associated with the positive sign; in a reflected wave either the current or the voltage must be reversed relative to the other, so that

* Except for circuit B, Case II (Section 4.3.2).

† It is assumed that L_0 and C_0, and hence v_0 and Z_0, are independent of frequency. The error involved in this assumption is not serious except for very accurate calculations.

the negative sign applies.

$$\left.\begin{aligned} &\text{Thus} \quad V_{Wn} = Z_0 . I_{Wn} \\ &\text{and} \quad V_{Rn} = (-Z_0) . I_{Rn} \end{aligned}\right\} \quad .. \quad (4)$$

2.3. *Reflection*

When the line is absorbing power from a source, it accepts energy at the same rate as would a physical resistance $+Z_0$. This energy is propagated along the line at the appropriate rate and delivered to the termination. Hence at the termination the line acts as a source of energy having an internal impedance of Z_0 ohms.

Now consider the effect of an open-circuit termination: it cannot accept power and, hence, all the incident energy must be reflected. This means that the reflected wave must be equal in magnitude to the incident wave. For an incident current wave I_{Wn}, the incident voltage wave is $V_{Wn} = Z_0 . I_{Wn}$. Since the termination is unable to support a current wave, the current in the reflected wave must reverse; i.e.,

$$I_{Rn} = -I_{Wn} \quad .. \quad .. \quad .. \quad .. \quad (5)$$

The voltage in the reflected wave is then

$$V_{Rn} = (-Z_0) . I_{Rn} = V_{Rn} = V_{Wn} \quad (6)$$

Thus the voltage wave is reflected without reversal of sign and so the voltage at the termination is

$$V_{Tn} = V_{Wn} + V_{Rn} = 2V_{Wn} \quad .. \quad (7)$$

2.4. *Thévenin's Theorem*

It can now be seen that at the above termination the line behaves as a source of power having an internal impedance Z_0 and open-circuit voltage $2V_{Wn}$, V_{Wn} being the voltage in the wave arriving at the termination. The waveforms in any termination can be determined by applying Thévenin's theorem and deriving the equivalent circuit shown in Fig. 2. The use of this equivalent circuit enables I_{Tn}, and hence all other waveforms, to be calculated. The same considerations apply to the calculation of I_{S2}, I_{S3}, etc., from the reflected waves returning to the left-hand end.

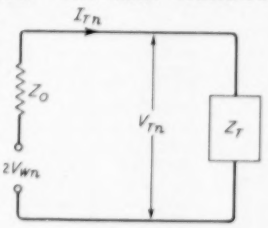


Fig. 2. *Equivalent circuit of line.*

2.5. *Attenuation*

The effect of losses in a physical line on its characteristic impedance can usually be neglected. The voltage–current relationship in every progressive wave is thus unaffected. It is then possible to base calculations on a lossless line and later to take the attenuation into account by introducing it as a correction factor.

The attenuation constant of a line is expressed as α nepers/metre, and a progressive wave travelling along l metres of line is attenuated by a factor $e^{-\alpha l}$, which is therefore the correction factor to be introduced to take line losses into account. Thus the first reflected wave returning to the left-hand end of the line is attenuated by a factor $e^{-\alpha(2l)}$ relative to the lossless case.

For a progressive wave in the form of a steady sinusoid, it is known that the attenuation constant increases with frequency. It follows that to calculate the precise effect of line attenuation on any transient waveform would involve a great deal of labour. The best that can be done simply is to choose the attenuation constant at a frequency dependent on the waveform considered and assume this value to be independent of frequency. Thus a first approximation to the effect of attenuation is obtained, and, provided the primary approximation is borne in mind, no serious errors should result.

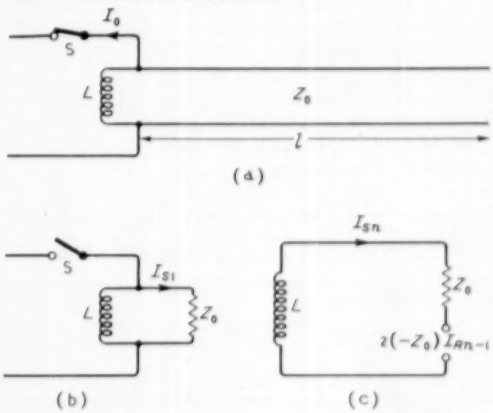


Fig. 3. *A line terminated in inductance L with stored energy is shown at (a), with an equivalent circuit for the calculation of I_{s1} at (b). A Thévenin equivalent is indicated at (c).*

3. Case I: Energy Stored Initially in Lumped Circuit Element

3.1. *Analysis of Circuit A*

3.1.1. *Simplifications in Procedure*

In the circuit to be analysed [Fig. 3(a)] the initial energy is $\frac{1}{2}LI_0^2$, stored in the inductance termination at the left-hand end of the line. Free oscillation begins when the switch S is opened. The termination at the right-hand end of the line is an open-circuit. This permits a simplification of the analysis, since it follows from Section 2 that

$$\left.\begin{aligned} I_{Rn} &= -I_{Wn} \\ V_{Tn} &= 2Z_0 I_{Wn} \\ I_{Sn} &= I_{Wn} + I_{Rn-1} \\ &= I_{Wn} - I_{Wn-1} \\ V_{Sn} &= Z_0 I_{Wn} + (-Z_0) I_{Rn-1} \\ &= Z_0 (I_{Wn} + I_{Wn-1}) \end{aligned}\right\} \quad .. \quad (8)$$

From the above equations it can be seen that the waveforms in any part of the circuit can be specified simply in terms of I_{Wn}. Hence if I_{Wn} is calculated the circuit analysis is complete. The following sections are devoted to this calculation.

3.1.2. *Calculation of* I_{W1}

In Section 2 it was shown that $I_{W1} = I_{S1}$; the equivalent circuit for the calculation of I_{S1} is shown in Fig. 3(b). At time zero the switch S is opened and the behaviour of the circuit is governed by the following differential equation:—

$$L\frac{d\,I_{S1}}{dt} - Z_0 . I_{S1} = 0 \qquad .. \qquad .. \qquad (9)$$

The complete solution of this equation is

$$I_{W1} = I_{S1} = I_0 e^{-z_0 t/L} \qquad .. \qquad .. \qquad (10)$$

3.1.3. *Recurrence Formula for* I_{Wn}

Fig. 3(c) shows the circuit obtained by the use of Thévenin's theorem to enable I_{Sn}, the nth current wave in the inductance, to be calculated. It must be remembered that by the principle of superposition for all values of n other than 1, the inductance is regarded as having no magnetic energy initially. Taking as positive a voltage increasing in a clockwise direction, the following equation is obtained from Fig. 3(c)

$$-L\frac{d\,I_{Sn}}{dt} - Z_0 . I_{Sn} - 2(-Z_0) . I_{Rn-1} = 0 \quad (11)$$

Since $I_{R1} = -I_{W1} = -I_0 e^{-z_0 t/L}$,

Equ. 11 can be used to evaluate I_{S2} and hence I_{W2}. It is found that

$$I_{W2} = I_0 e^{-z_0 t/L}\left\{1 - 2\frac{Z_0 t}{L}\right\} \qquad .. \qquad (12)$$

The equation for I_{Wn} then takes the form

$$I_{Wn} = I_0 e^{-z_0 t/L}\{P_n\} \qquad .. \qquad .. \qquad (13)$$

where P_n is a polynomial in $\{Z_0 t/L\}$.

TABLE 1

$$I_{W1} = I_0 e^{-x}$$

$$I_{W2} = I_0 e^{-x}(1 - 2x)$$

$$I_{W3} = I_0 e^{-x}(1 - 4x + 2x^2)$$

$$I_{W4} = I_0 e^{-x}\left(1 - 6x + 6x^2 - \frac{4}{3}x^3\right)$$

$$I_{W5} = I_0 e^{-x}\left(1 - 8x + 12x^2 - \frac{16}{3}x^3 + \frac{2}{3}x^4\right)$$

$$I_{W6} = I_0 e^{-x}\left(1 - 10x + 20x^2 - \frac{40}{3}x^3 + \frac{10}{3}x^4 - \frac{4}{15}x^5\right)$$

$$I_{W7} = I_0 e^{-x}\left(1 - 12x + 30x^2 - \frac{80}{3}x^3 + \frac{30}{3}x^4 - \frac{24}{15}x^5 + \frac{4}{45}x^6\right)$$

$$I_{W8} = I_0 e^{-x}\left(1 - 14x + 42x^2 - \frac{140}{3}x^3 + \frac{70}{3}x^4 - \frac{84}{15}x^5 + \frac{28}{45}x^6 - \frac{8}{315}x^7\right)$$

$$I_{W9} = I_0 e^{-x}\left(1 - 16x + 56x^2 - \frac{224}{3}x^3 + \frac{140}{3}x^4 - \frac{224}{15}x^5 + \frac{112}{45}x^6 - \frac{64}{315}x^7 + \frac{2}{315}x^8\right)$$

$$I_{W10} = I_0 e^{-x}\left(1 - 18x + 72x^2 - \frac{336}{3}x^3 + \frac{252}{3}x^4 - \frac{504}{15}x^5 + \frac{336}{45}x^6 - \frac{288}{315}x^7 + \frac{18}{315}x^8 - \frac{4}{2835}x^9\right)$$

Equ. (11) can be used to obtain a recurrence formula for P_n, thus enabling successive equations for I_{Wn} to be obtained with the minimum difficulty.

If Equ. (11) is transformed by writing the dependent variables in terms of I_{Wn} and I_{Wn-1}, while at the same time changing the independent variable from t to $\{Z_0 t/L\}$, the following equation is obtained:

$$-Z_0 . D\{I_{Wn} - I_{Wn-1}\} - Z_0\{I_{Wn} - I_{Wn-1}\} = +2Z_0 I_{Wn-1} \qquad .. \qquad .. \qquad (14)$$

where $$D \equiv \frac{d}{d\left\{\frac{Z_0 t}{L}\right\}} = \frac{L}{Z_0} . \frac{d}{dt}$$

Substituting Equ. (13) into (14), the result is

$$D\{P_n - P_{n-1}\} = -2P_{n-1} \qquad .. \qquad .. \qquad (15)$$

$$\text{Hence } P_n = \text{constant} + P_{n-1} - 2\int P_{n-1} \qquad (16)$$

The values of P_1 and P_2 obtained from Equs. (10) and (12) show that the constant is zero, so that the recurrence relation for P_n is

$$P_n = P_{n-1} - 2\int P_{n-1} \qquad .. \qquad .. \qquad (17)$$

3.1.4. *Summary of Results*

Using Equ. (17) the successive expressions for I_{Wn} can be readily built up; the first 10 equations are tabulated in Table 1, where x is written for $\{Z_0 t/L\}$. These equations have been evaluated in the range of x from 0 to 2 and the results are tabulated in Table 2. The results given in Table 2 have been plotted in Figs. 4 and 5 to show the shape of the waveforms that occur.

3.1.5. *Example*

Tables 1 and 2 and Figs. 4 and 5 are generalized results applicable to any values of l, I_0, L and Z_0, so that the evaluation of any specific case requires little work. As an example, suppose it is required to calculate the voltage–time curve at the open end of the transmission line for the following case:

$I_0 = 2$ amps
$L = 10^{-3}$ henry
$Z_0 = 100$ ohms
$v_0 = 2 \times 10^8$ metres/second

$$l = 200 \text{ metres}$$

$$x = \frac{Z_0 l}{L} = 10^5 t$$

$$\frac{2l}{v_0} = 2 \times 10^{-6} \text{ second}$$

From Section 2.1 it will be seen that the resultant voltage–time curve is

$$V_{T1} + V_{T2} + V_{T3} + \text{etc.},$$

with V_{Tn} commencing $2l/v_0$ seconds after V_{Tn-1}. In the present example the delay is 2×10^{-6} second.

The voltage–time wave obtained is plotted in Fig. 6, showing the first cycle of a periodic wave which is undamped because the circuit is lossless.

Using Equs. (2) and (3) and the above data it is easy to show that the total capacitance of the transmission line ($C_0 l$) is 0·01μF. If the transmission line in the above example be replaced by a lumped capacitance of 0·01 μF, the waveform of the voltage across the capacitor is also plotted in Fig. 6 for the purpose of comparison.

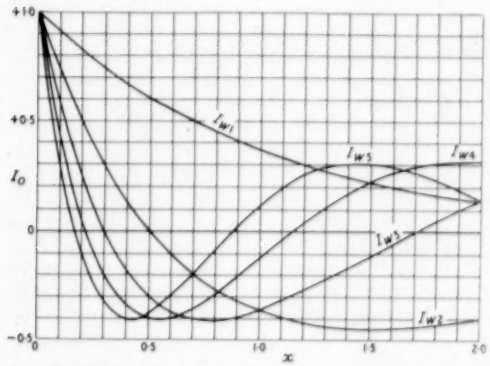
3.2. *Analysis of Circuit B*

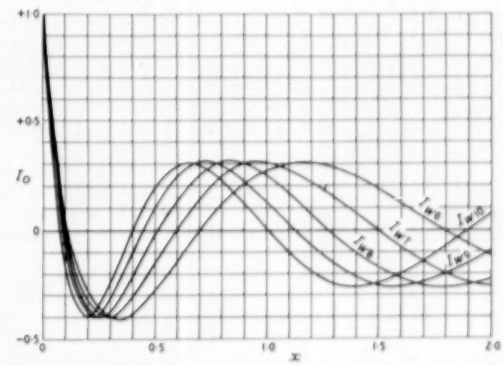
3.2.1. *Simplifications in Procedure*

The circuit is shown in Fig. 7(a) and the initial energy is $\frac{1}{2}CV_0^2$ stored in the capacitor. The oscillation commences when the switch S is closed at time zero. The termination at the right-hand end of the transmission line is a short-circuit, permitting the following simplified equations:—

$$\left.\begin{aligned} I_{Rn} &= I_{Wn} \\ I_{Tn} &= 2I_{Wn} \\ I_{Sn} &= I_{Wn} + I_{Rn-1} \\ &= I_{Wn} + I_{Wn-1} \\ V_{Sn} &= Z_0 \cdot I_{Wn} + (-Z_0) \cdot I_{Rn-1} \\ &= Z_0(I_{Wn} - I_{Wn-1}) \end{aligned}\right\} \quad (18)$$

As before, all the circuit waveforms can be simply expressed in terms of I_{Wn}; thus, as in





Figs. 4 (left) *and* 5 (right). *Curves plotted from the figures of Table* 2, *showing the waveforms in a line connected to an inductance having stored energy, as in Fig.* 3.

TABLE 2

x	I_{W1}/I_0	I_{W2}/I_0	I_{W3}/I_0	I_{W4}/I_0	I_{W5}/I_0	I_{W6}/I_0	I_{W7}/I_0	I_{W8}/I_0	I_{W9}/I_0	I_{W10}/I_0
0	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000	1·0000
0·1	0·9048	0·7238	0·5610	0·4150	0·2848	0·1692	0·0672	−0·0221	−0·0997	−0·1664
0·2	0·8187	0·4912	0·2292	0·0240	−0·1323	−0·2468	−0·3257	−0·3748	−0·3989	−0·4027
0·3	0·7048	0·2963	−0·0148	−0·2193	−0·3397	−0·3953	−0·4021	−0·3735	−0·3204	−0·2517
0·4	0·6703	0·1341	−0·1877	−0·3251	−0·4050	−0·3826	−0·3128	−0·2173	−0·1120	−0·0084
0·5	0·6065	0·0000	−0·3033	−0·4043	−0·3791	−0·2830	−0·1558	−0·0245	0·0834	0·1878
0·6	0·5488	−0·1098	−0·3732	−0·3995	−0·2994	−0·1475	−0·0086	0·1410	0·2357	0·2883
0·7	0·4966	−0·1986	−0·4072	−0·3562	−0·1933	−0·0088	0·1469	0·2511	0·2983	0·2938
0·8	0·4493	−0·2696	−0·4134	−0·2888	−0·0798	0·1129	0·2434	0·2996	0·2888	0·2279
0·9	0·4066	−0·3253	−0·3985	−0·2082	0·0282	0·2072	0·2942	0·2931	0·2263	0·1219
1·0	0·3679	−0·3679	−0·3679	−0·1226	0·1226	0·2698	0·3025	0·2441	0·1320	0·0030
1·1	0·3329	−0·3995	−0·3262	−0·0392	0·1989	0·3010	0·2757	0·1674	0·0266	−0·1051
1·2	0·3012	−0·4217	−0·2771	0·0410	0·2549	0·3037	0·2229	0·0772	−0·0734	−0·1877
1·3	0·2725	−0·4360	−0·2235	0·1119	0·2907	0·2826	0·1533	−0·0144	−0·1570	−0·2399
1·4	0·2466	−0·4439	−0·1677	0·1729	0·3074	0·2428	0·0757	−0·0979	−0·2154	−0·2528
1·5	0·2231	−0·4462	−0·1116	0·2231	0·3068	0·1896	−0·0028	−0·1665	−0·2474	−0·2367
1·6	0·2019	−0·4442	−0·0565	0·2622	0·2915	0·1282	−0·0769	−0·2193	−0·2576	−0·2002
1·7	0·1827	−0·4385	−0·0037	0·2904	0·2641	0·0635	−0·1397	−0·2459	−0·2394	−0·1356
1·8	0·1653	−0·4298	0·0463	0·3081	0·2272	−0·0011	−0·1907	−0·2551	−0·1967	−0·0660
1·9	0·1496	−0·4189	0·0928	0·3164	0·1835	−0·0622	−0·2276	−0·2457	−0·1442	0·0093
2·0	0·1353	−0·4059	0·1353	0·3157	0·1353	−0·1173	−0·2496	−0·2203	−0·0846	0·0737

Section 3.1, it is only necessary to calculate I_{Wn} to obtain the complete solution of the circuit.

3.2.2. *Calculation of* I_{Wn}

As in Section 3.1.2 I_{S1} is calculated, giving I_{W1} immediately. The equivalent circuit used in the calculation is shown in Fig. 7(b). At time zero the switch S is closed and the capacitor, initially charged to V_0 volts, discharges into the characteristic impedance of the line. The behaviour of the circuit is governed by the following equation:—

$$\frac{CV_0 - \int_0^t I_{S1}\,dt}{C} - Z_0 \,.\, I_{S1} = 0 \quad .. \quad (19)$$

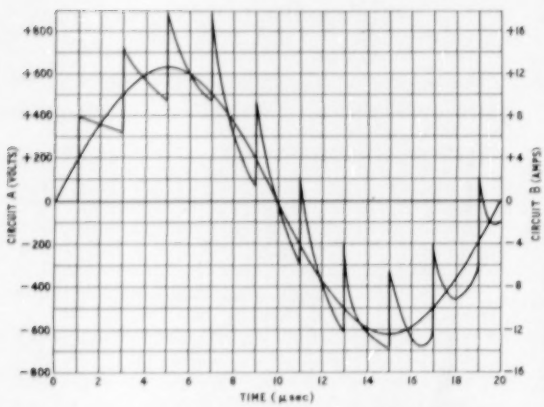


Fig. 6. *Current and voltage waveforms for particular conditions in the circuits of Figs. 3 and 7.*

As before, the sign convention adopted is that current circulating in a clockwise direction is positive, and a voltage increasing in the same direction is positive.

The complete solution for Equ. (19) is

$$I_{W1} = I_{S1} = I_0 e^{-t/CZ_0} \quad .. \quad .. \quad (20)$$

where $I_0 = \dfrac{V_0}{Z_0}$.

3.2.3. *Recurrence Formula for* I_{Wn}

The application of Thévenin's theorem enables the equivalent circuit of Fig. 7(c) to be derived for the calculation of I_{Sn}, the nth current wave in the capacitor. The principle of superposition used in the calculation requires that for all values of n other than 1, the capacitor is taken as being initially uncharged. The equation obtained from the circuit is

$$-\frac{1}{C}\int_0^t I_{Sn}\,dt - Z_0\,I_{Sn} - \{2(-Z_0)I_{Rn-1}\} = 0 \quad .. \quad .. \quad (21)$$

Since $I_{R1} = I_{W1}$, Equ. (21) can be used to evaluate I_{S2} and hence I_{W2}. It is found that

$$I_{W2} = I_0 e^{-t/CZ_0}\left\{1 - \frac{2t}{CZ_0}\right\} \quad .. \quad .. \quad (22)$$

In general $I_{Wn} = I_0 e^{-t/CZ_0}\{P_n\}$ .. .. (23)

where P_n is a polynomial in $\{t/CZ_0\}$.

A recurrence formula for P_n can be obtained from Equ. (21); the equation is transformed by writing the dependent variables in terms of I_{Wn} and I_{Wn-1}, while at the same time changing the independent variable from t to (t/CZ_0). The following equation is the result

$$P_n = \text{constant} + P_{n-1} - 2\int P_{n-1} \quad (24)$$

The values of P_1 and P_2 obtained from Equs. (20) and (22) show that the constant of integration is zero.

$$\text{Therefore} \quad P_n = P_{n-1} - 2\int P_{n-1} \,.. \quad (25)$$

is the recurrence relation required.

3.2.4. *Summary of Results*

By comparison of Sections 3.2.3 and 3.1.3, it is clear that the equations for I_{Wn} in circuit B will take exactly the same form as for circuit A, provided only that $Z_0 t/L$ is replaced by t/CZ_0. It follows at once that Tables 1 and 2 and Figs. 4 and 5 apply equally to circuit B if x is taken to represent t/CZ_0. Thus, as might be expected, there is a close correspondence in the behaviour of the two circuits.

3.2.5. *Example*

As an example of this similarity, calculate the current–time curve at the short-circuit termination

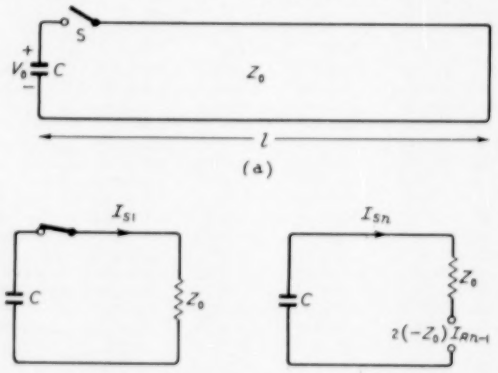


Fig. 7. *A line terminated by a charged capacitor is shown at (a), with an equivalent circuit at (b) and the Thévenin equivalent at (c).*

for the following case:—

$$V_0 = 200 \text{ volts}$$
$$C = 2 \times 10^{-7} \text{ farad}$$
$$Z_0 = 50 \text{ ohms}$$
$$v_0 = 150 \times 10^6 \text{ metres/second}$$
$$l = 150 \text{ metres}$$

therefore $I_0 = 4$ amps

and $$x = \frac{t}{cZ_0} = 10^5 t$$

$$\frac{2l}{v_0} = 2 \times 10^{-6} \text{ second}$$

The resulting current–time curve is given by Fig. 6 simply by changing the ordinate scale as shown.

The total inductance of the transmission line can be readily shown to be 5×10^{-5} henry. If the transmission line in the above example is replaced by this lumped inductance, the current–time curve in the inductance is given by the sinusoid in Fig. 6 in conjunction with the second ordinate scale.

4. Case II: Energy Stored Initially in the Transmission Line

4.1. *Introduction*

The first problem to arise is the method of representation of the line as a source of power when the energy is initially uniformly distributed along the line as electrostatic or magnetic energy. The experience gained in the preceding sections suggests that Thévenin's theorem could again be used.

When a termination is placed across the line, energy begins to flow from the line into the termination. However, the application of Thévenin's theorem leads to a first progressive wave which travels away from the termination. This apparent contradiction is resolved if the limitations of the principle of superposition are borne in mind. In fact the equations can be verified directly by showing that the total energy in the system remains constant.

4.2. *Analysis of Circuit A*

4.2.1. *Initial Procedure*

The circuit to be considered is shown as Fig. 8(a); initially the line is charged to a voltage V_0, and at time zero the switch S is closed.

The open-circuit termination at the right-hand end of the line allows Equ. (8) (Section 3.1.1) to apply to this problem as well. For the purpose of calculating I_{S1}, Thévenin's theorem is used to replace the line by a generator having an internal impedance of Z_0 ohms and an open-circuit voltage V_0 volts. For the calculation of I_{S2} and subsequent waves the principle of superposition requires that the line be regarded as initially uncharged, so that the technique used in the preceding sections will then apply.

4.2.2. *Calculation of I_{W1}*

As before, $I_{W1} = I_{S1}$, so that I_{S1} must first be calculated; the equivalent circuit of Fig. 8(b) is derived for this purpose. Using the same convention of signs as previously, the equation obtained is

$$-L\frac{dI_{S1}}{dt} - Z_0 . I_{S1} - V_0 = 0 \quad .. \quad (26)$$

The solution of this equation is

$$I_{W1} = I_{S1} = -I_0\{1 - e^{-Z_0 t/L}\} \quad .. \quad (27)$$

where $I_0 = \frac{V_0}{Z_0}$.

4.2.3. *Recurrence Formula for I_{Wn}*

The equivalent circuit for calculating I_{Sn} is shown in Fig. 8(c). As in Section 3.1.3, the following equation is obtained:

$$-L\frac{dI_{Sn}}{dt} - Z_0 I_{Sn} - 2(-Z_0)I_{Rn-1} = 0 \quad (28)$$

Since $I_{R1} = -I_{W1}$, this equation can be used to solve for I_{S2} and I_{W2}. It is found that

$$I_{W2} = +I_0\left[1 - e^{-Z_0 t/L}\left\{1 + \frac{2Z_0 t}{L}\right\}\right] .. \quad (29)$$

The general equation for I_{Wn} is of the form

$$I_{Wn} = (-1)^n I_0 [1 - e^{-Z_0 t/L}\{P_n\}] \quad .. \quad (30)$$

where P_n is a polynomial in $\{Z_0 t/L\}$.

Equ. (28) can be used to obtain a recurrence formula for P_n, by expressing the dependent variables in terms of I_{Wn} and I_{Wn-1}, while changing the independent variable from t to $\{Z_0 t/L\}$. The result obtained is

$$P_n = \text{constant} - P_{n-1} + 2\int P_{n-1}$$

By comparing P_1 and P_2 obtained from Equs. (27) and (29) the constant is evaluated as 2.

Hence the required recurrence relation is

$$P_n = 2 - P_{n-1} + 2\int P_{n-1} \; .. \quad .. \quad (31)$$

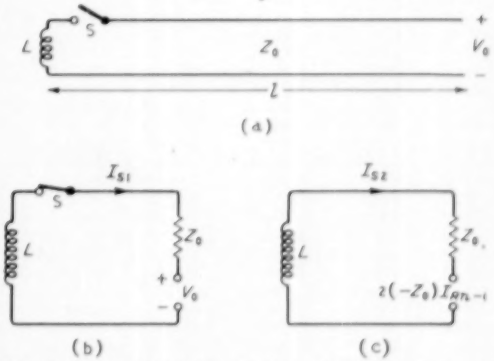
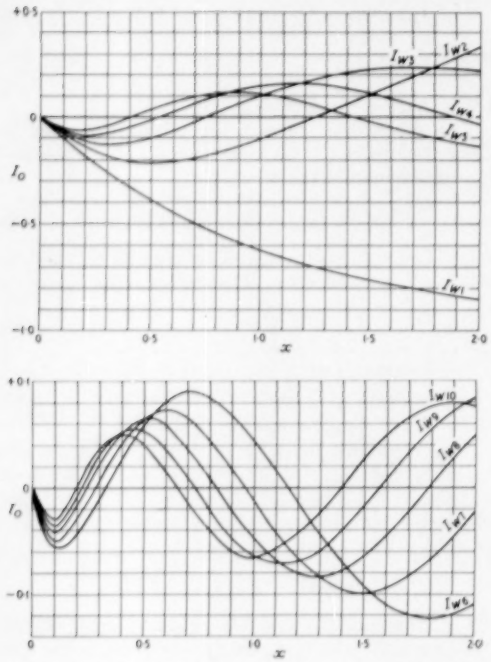


Fig. 8. *Line with stored energy and terminated by an inductance (a) and its equivalent circuits (b) and (c).*

4.2.4. *Summary of Results*

By the use of Equ. (31) successive expressions for I_{Wn} can be built up rapidly. The equations up to I_{W10} are tabulated in Table 3 where x is written for Z_0t/L. These equations have been evaluated in the range of x from 0 to 2 and the results are tabulated in Table 4; these figures have also been plotted as the curves of Figs. 9 and 10.



Figs. 9 (above) *and* 10 (below). *Curves plotted from the figures of Table 3, showing the waveforms in a line having stored energy and terminated by an inductance, as in Fig. 8.*

It is interesting to note that the end case $L = 0$ corresponds to the application of a short-circuit to the line. In this case I_{Wn} reduces to $(-1)^n I_0$.

4.2.5. *Example*

As an example of the application of the results obtained, suppose it is required to calculate the voltage waveform at the open-circuit termination of the line for the following case:—

$V_0 = 200$ volts.

Other data as in Section 3.1.5.

The voltage–time waveform obtained is plotted in Fig. 11, showing the first cycle of an undamped periodic curve approximating to a cosine wave.

Again following Section 3.1.5, if the line is replaced by a lumped capacitance of 0·01 μF initially charged to 200 volts, the voltage waveform across the capacitor is the cosine curve shown in Fig. 11.

4.3. *Analysis of Circuit B*

4.3.1. *Initial Procedure*

The circuit to be analysed is shown as Fig. 12(a); at time zero the external circuit driving a steady current I_0 through the transmission line is interrupted by opening the switch S.

The short-circuit termination at the right-hand end of the line permits the application of Equ. (18) (Section 3.2.1) to this problem.

For the purpose of applying Thévenin's theorem to the line as a source of energy it is necessary to determine the voltage developed at the left-hand end of the line under these conditions if the termination there is an open-circuit. It is clear that at time zero, the current I_0 at this termination must in this case fall instantly to zero; this necessitates a progressive current wave as a negative step function $-I_0$ with an associated voltage step of $-V_0$. The equivalent circuit for the line is thus a generator of open-circuit voltage $-V_0$ and internal impedance Z_0 ohms. For the

TABLE 3

$$I_{W1} = -I_0(1 - e^{-x})$$

$$I_{W2} = +I_0[1 - e^{-x}(1 + 2x)]$$

$$I_{W3} = -I_0[1 - e^{-x}(1 + 2x^2)]$$

$$I_{W4} = +I_0\left[1 - e^{-x}\left(1 + 2x - 2x^2 + \frac{4}{3}x^3\right)\right]$$

$$I_{W5} = -I_0\left[1 - e^{-x}\left(1 + 4x^2 - \frac{8}{3}x^3 + \frac{2}{3}x^4\right)\right]$$

$$I_{W6} = +I_0\left[1 - e^{-x}\left(1 + 2x - 4x^2 + \frac{16}{3}x^3 - \frac{6}{3}x^4 + \frac{4}{15}x^5\right)\right]$$

$$I_{W7} = -I_0\left[1 - e^{-x}\left(1 + 6x^2 - \frac{24}{3}x^3 + \frac{14}{3}x^4 - \frac{16}{15}x^5 + \frac{4}{45}x^6\right)\right]$$

$$I_{W8} = +I_0\left[1 - e^{-x}\left(1 + 2x - 6x^2 + \frac{36}{3}x^3 - \frac{26}{3}x^4 + \frac{44}{15}x^5 - \frac{20}{45}x^6 + \frac{8}{315}x^7\right)\right]$$

$$I_{W9} = -I_0\left[1 - e^{-x}\left(1 + 8x^2 - \frac{48}{3}x^3 + \frac{44}{3}x^4 - \frac{96}{15}x^5 + \frac{64}{45}x^6 - \frac{48}{315}x^7 + \frac{2}{315}x^8\right)\right]$$

$$I_{W10} = +I_0\left[1 - e^{-x}\left(1 + 2x - 8x^2 + \frac{64}{3}x^3 - \frac{68}{3}x^4 + \frac{184}{15}x^5 - \frac{160}{45}x^6 + \frac{176}{315}x^7 - \frac{14}{315}x^8 + \frac{4}{2835}x^9\right)\right]$$

calculation of I_{S2} and subsequent waves the procedure of Section 3.2.3 is followed.

4.3.2. *Calculation of I_{W1}*

The circuit used for calculating I_{S1} is given in Fig. 12(b); the equation obtained is

$$-\frac{1}{C}\int_0^t I_{S1}\,dt - Z_0 I_{S1} - (-V_0) = 0 \qquad (32)$$

The complete solution of this is

$$I_{S1} = I_0 e^{-t/CZ_0} \qquad (33)$$

But, by Kirchhoff's law,

$$I_{S1} = I_0 + I_{W1} \qquad (34)$$

Therefore $I_{W1} = -I_0\,[1 - e^{-t/CZ_0}]$ (35)

4.3.3. *Recurrence Formula for I_{Wn}*

Fig. 12(c) shows the circuit used for calculating I_{Sn}; as in Section 3.2.3, the following equation is obtained:

$$-\frac{1}{C}\int_0^t I_{Sn}\,.\,dt - Z_0\,.\,I_{Sn} - 2(-Z_0)\,.\,I_{Rn-1} = 0 \qquad (36)$$

Since $I_{R1} = I_{W1}$, Equ. (36) can be used to calculate I_{S2} and hence I_{W2}. The result is

$$I_{W2} = +I_0\left[1 - e^{-t/CZ_0}\left\{1 + \frac{2t}{CZ_0}\right\}\right] \qquad (37)$$

and in general $I_{Wn} = (-1)^n\, I_0[1 - e^{-t/CZ_0}\{P_n\}]$ (38)

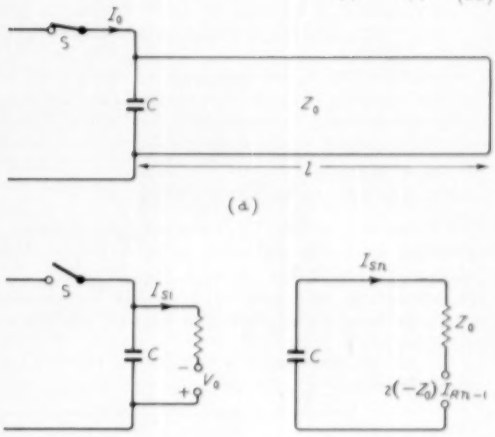


Fig. 12. *Line with stored energy connected to a capacitor (a) and equivalent circuits (b) and (c).*

To obtain the recurrence formula, Equ. (36) is transformed into

$$D\,\{I_{Wn} - I_{Wn-1}\} = -I_{Wn} - I_{Wn-1} \qquad (39)$$

Hence the recurrence relation is

$$P_n = 2 - P_{n-1} + 2\int P_{n-1} \qquad (40)$$

4.3.4. *Summary of Results*

By comparison of these results with Section 4.2, it is clear that the equations of Table 3 also

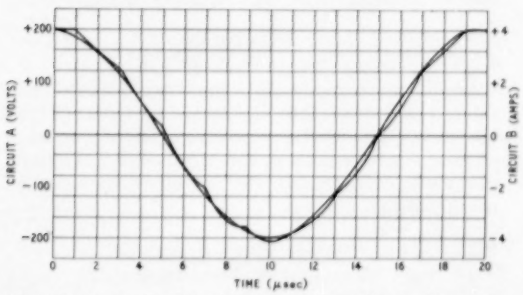


Fig. 11. *Current and voltage in a line with stored energy for particular conditions.*

TABLE 4

x	I_{W1}/I_0	I_{W2}/I_0	I_{W3}/I_0	I_{W4}/I_0	I_{W5}/I_0	I_{W6}/I_0	I_{W7}/I_0	I_{W8}/I_0	I_{W9}/I_0	I_{W10}/I_0
0	0	0	0	0	0	0	0	0	0	0
0·1	−0·0952	−0·0858	−0·0771	−0·0689	−0·0613	−0·0542	−0·0477	−0·0415	−0·0360	−0·0307
0·2	−0·1813	−0·1462	−0·1158	−0·0894	−0·0669	−0·0476	−0·0314	−0·0177	−0·0065	−0·0027
0·3	−0·2592	−0·1853	−0·1259	−0·0786	−0·0419	−0·0137	−0·0069	−0·0217	−0·0314	−0·0372
0·4	−0·3297	−0·2065	−0·1152	−0·0492	−0·0037	−0·0261	−0·0436	−0·0519	−0·0534	−0·0502
0·5	−0·3935	−0·2130	−0·0903	−0·0108	−0·0361	−0·0599	−0·0673	−0·0640	−0·0539	−0·0405
0·6	−0·4512	−0·2074	−0·0561	−0·0297	−0·0704	−0·0816	−0·0746	−0·0578	−0·0368	−0·0158
0·7	−0·5034	−0·1918	−0·0167	−0·0677	−0·0952	−0·0893	−0·0665	−0·0376	−0·0095	−0·0140
0·8	−0·5507	−0·1682	−0·0244	−0·1002	−0·1087	−0·0840	−0·0465	−0·0097	−0·0204	−0·0405
0·9	−0·5934	−0·1385	−0·0653	−0·1250	−0·1114	−0·0676	−0·0194	−0·0205	−0·0463	−0·0580
1·0	−0·6321	−0·1037	−0·1037	−0·1416	−0·1037	−0·0435	−0·0108	−0·0476	−0·0645	−0·0645
1·1	−0·6671	−0·0653	−0·1385	−0·1496	−0·0875	−0·0146	−0·0399	−0·0684	−0·0724	−0·0593
1·2	−0·6988	−0·0241	−0·1687	−0·1494	−0·0646	−0·0158	−0·0651	−0·0806	−0·0700	−0·0443
1·3	−0·7275	0·0190	−0·1936	−0·1418	−0·0370	−0·0451	−0·0841	−0·0837	−0·0589	−0·0240
1·4	−0·7534	0·0629	−0·2133	−0·1274	−0·0070	−0·0716	−0·0955	−0·0780	−0·0395	−0·0021
1·5	−0·7769	0·1076	−0·2271	−0·1076	−0·0239	−0·0932	−0·0992	−0·0645	−0·0163	0·0269
1·6	−0·7981	0·1530	−0·2356	−0·0831	−0·0538	−0·1094	−0·0956	−0·0468	−0·0085	0·0489
1·7	−0·8173	0·1961	−0·2387	−0·0553	−0·0816	−0·1190	−0·0841	−0·0221	−0·0337	0·0651
1·8	−0·8347	0·2396	−0·2364	−0·0254	−0·1063	−0·1220	−0·0676	−0·0032	−0·0553	0·0754
1·9	−0·8504	0·2819	−0·2297	−0·0061	−0·1267	−0·1190	−0·0464	−0·0283	−0·0732	0·0803
2·0	−0·8647	0·3235	−0·2177	−0·0373	−0·1431	−0·1095	−0·0228	−0·0520	−0·0837	0·0746

hold for circuit B, provided x is taken to represent t/CZ_0. It follows that the results given in Table 4 and in Figs. 9 and 10 also apply.

It can be noted in passing that for the end case $C = 0$, the formula for I_{Wn} reduces simply to

$$I_{Wn} = (-1)^n I_0 \qquad .. \qquad .. \qquad .. \qquad (41)$$

4.3.5. *Example*

To demonstrate the similarity of behaviour of the two circuits, suppose it is required to calculate the current–time curve for the short-circuit termination in the following case:—

$I_0 = 4$ amps.

Other data as in Section 3.2.5.

The waveform of Fig. 11 is the solution obtained, provided that the ordinate scale is changed as indicated. The cosine curve in Fig. 11 then shows the waveform obtained in a 50-μH inductance if this is used to replace the line in the above problem.

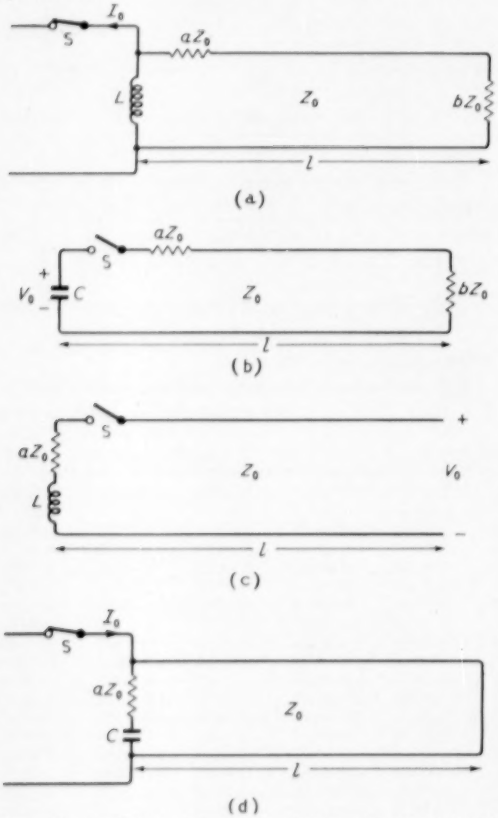


Fig. 13. *Conditions for circuit losses. At (a) and (b) resistance is included both in the line and the remote terminations. In (c) and (d) resistance is added in series with the reactive termination.*

4.4. *Comparison of Case I and Case II*

Since the only difference between Case I and Case II is the method of initial storage of energy it is to be expected that the circuit waveforms obtained will bear some close relationship to each other.

If the equations of Tables 2 and 3 are examined, it will be found that

$$\underset{\text{Case I}}{[-I_0 + I_{W1}]} = \underset{\text{Case II}}{[I_{W1}]} \qquad .. \qquad (42)$$

$$\text{Also } \underset{\text{Case I}}{[I_{Wn} - I_{Wn-1}]} = \underset{\text{Case II}}{[I_{Wn} + I_{Wn-1}]} \qquad (43)$$

It follows that the two sets of equations are rigidly interrelated.

5. Effect of Additional Circuit Components

5.1. *Introduction*

In this section the effect of the introduction of certain modifications to the circuits previously analysed will be considered. The method of analysis used is the same as that employed in previous sections; for this reason the examples chosen will not be analysed in detail, but the results obtained will be discussed briefly.

5.2. *Effect of Power Dissipation*

5.2.1. *Effect of Losses in the Line*

Losses in transmission lines have been considered in Section 2.5. It should be stressed that line losses will produce a cumulative attenuation of progressive waves as the number of reflections increases, even though the waves be regarded as mathematical fictions.

5.2.2. *Line Terminating in a Resistance*

If the transmission line terminates in a resistance bZ_0 ohms, the conditions there can be solved as usual by the application of Thévenin's theorem. The result is

$$I_{Rn} = \left\{\frac{1-b}{1+b}\right\} I_{Wn} \qquad .. \qquad .. \qquad (44)$$

$$\text{and} \quad I_{Tn} = \left\{\frac{2}{1+b}\right\} I_{Wn} \qquad .. \qquad .. \qquad (45)$$

The fraction $\dfrac{1-b}{1+b}$ is termed the reflection factor and it will be realized that even though it may be nearly unity, the cumulative effect is such that waveforms of high order are considerably reduced in magnitude. This cumulative effect can be seen in the formulae given in Section 5.2.3 and by the example in Section 5.2.4.

5.2.3. *Effect of Circuit Losses on Previous Calculations*

The formulae obtained in Sections 3 and 4 need to be modified if resistances are included in the

line terminations. The circuits considered are redrawn in Fig. 13 to include a resistance aZ_0 in series with the left-hand termination in every case, and a resistance bZ_0 in series with the right-hand termination for the first two cases. Analysis of these circuits give the results outlined in Table 5.

It will be seen that the presence of the termination bZ_0 only influences the amplitudes of successive waves. The inclusion of aZ_0 influences wave shape as well as amplitude, since the factor a appears in the recurrence formulae. It will be noticed that in the last two cases the integration constant in the recurrence formulae is a function of n.

Free oscillations for Case II operation with purely resistive terminations are an end case of these results; i.e., by taking $L = 0$ for circuit A and $C = \infty$ for circuit B.

5.2.4. *Example*

As an illustration of the effect of circuit losses, consider the circuit of Fig. 13(a) having the following parameters:—

$a = 0$

$b = 10$

Other details as in Section 3.1.5.

By the application of Thévenin's theorem to the right-hand termination it follows that:

$$V_{Tn} = \frac{2b}{1+b} Z_0 \cdot I_{Wn} \qquad .. \qquad .. \qquad (46)$$

The voltage–time waveform at this termination is shown in Fig. 14 in which the sinusoid of Fig. 6 is repeated for comparison. It will be seen that the waveform approximates to a damped sine wave.

If, in Fig. 13(b)

$a = 0$

$b = 1/10$

and other details are as in Section 3.2.5, then the waveform of Fig. 14 also represents the current-time curve in the right-hand termination.

The cumulative effect of the reflection factor

TABLE 5

	CASE I	
	Circuit A	Circuit B
Circuit diagram	Fig. 13 (a)	Fig. 13 (b)
General equation	$I_{Wn} = I_0\left\{\frac{b-1}{(a+1)(b+1)}\right\}^{n-1} \cdot e^{-xP_n}$	$I_{Wn} = \frac{I_0}{(1+a)}\left\{\frac{1-b}{(1+a)(1-b)}\right\}^{n-1} \cdot e^{-xP_n}$
P_1	1	1
Recurrence formula	$P_n = (1+a)P_{n-1} - 2\int P_{n-1}$	$P_n = (1-a)P_{n-1} - 2\int P_{n-1}$
X	$\frac{Z_0(1+a)t}{L}$	$\frac{t}{CZ_0(1+a)}$
	CASE II	
	Circuit A	Circuit B
Circuit diagram	Fig. 13 (c)	Fig. 13 (d)
General equation	$I_{Wn} = (-1)^n \frac{I_0}{(1+a)^n}[(1-a)^{n-1} - e^{-xP_n}]$	$I_{Wn} = (-1)^n \frac{I_0}{(1+a)^n}[(1+a)^n - e^{-xP_n}]$
P_1	1	1
Recurrence formula	$P_n = 2(1-a)^{n-2} - (1+a)P_{n-1} + 2\int P_{n-1}$	$P_n = 2(1+a)^{n-1} - (1-a)P_{n-1} + 2\int P_{n-1}$
X	$\frac{Z_0(1+a)t}{L}$	$\frac{t}{CZ_0(1+a)}$

in reducing the amplitudes of successive waves can be clearly seen.

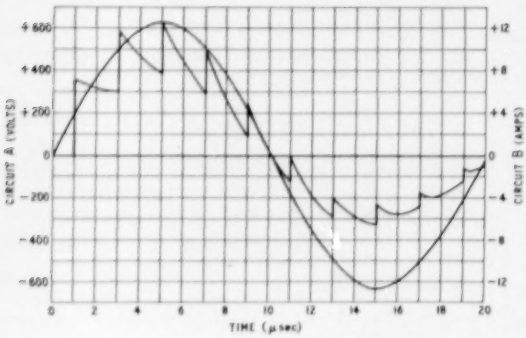


Fig. 14. *Current and voltages for the conditions of Fig. 13(a).*

5.3. *Presence of Both Inductance and Capacitance*

When both inductance and capacitance are present, either in the same or in opposite terminations, analysis of the circuit leads to complicated results. Instead of only one 'time constant' being involved as before, two now occur, and no simple recurrence relation can be found. With complex terminations (i.e., terminations involving one or more capacitor, inductance and resistance) second- or higher-order differential equations have to be solved to determine waveforms on reflection. The expressions obtained rapidly become unwieldy and the problem is perhaps best treated by purely numerical methods.

6. Conclusion

The method of analysis outlined is suitable for the calculation of waveforms in distributed circuits and is useful for determining the effect of measuring circuits and cables on waveforms which are to be recorded. The method can be applied to the calculation of free oscillations in cable systems, as in the paper, but except for certain simple cases the results of such an analysis are unwieldy.

NYQUIST'S STABILITY CRITERION

Proof using Laplace Transform Calculus

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SUMMARY.—In this paper the Nyquist Criterion of Stability is derived using the methods of the Laplace Transform Calculus.

The proof is divided into four parts:—(1) The necessary and sufficient condition for a stable response of a linear lumped-constant network to a step function input is obtained in terms of restrictions on the positions of the poles of the network transfer function in the S plane. (2) The above restrictions are interpreted in terms of the poles and zeros of the transfer functions of the forward and feedback sections of a single-loop feedback system. (3) The relation between the open-loop frequency response, of the feedback system and the restrictions necessary and sufficient for stability is derived. (4) Finally, the stability of response to a step-function input is shown to be a sufficient condition for the stability of response to any bounded input.

A brief discussion of the assumptions upon which the proof is founded is given.

In the conclusions it is shown that non-zero initial conditions do not modify the criterion and a method of applying the criterion to multiloop feedback systems is given.

Introduction

THE Nyquist criterion of stability is fundamental to the theory of linear feedback systems. Attempts to determine a criterion of stability from steady-state arguments produce results which are not always in agreement with experiment, owing to the fact that such an analysis neglects to investigate the stability of an oscillation. Although the analysis contained in Nyquist's proof of the theorem[1] is a complete discussion of the problem of stability, the mathematical presentation tends to obscure the main argument. Other attempts[2,3,4,5,6] to derive the criterion have either sacrificed generality in favour of simplicity or adopted a steady-state approach.

The proof which is presented in this paper employs a branch of mathematics, the Laplace Transform Calculus, which was little known when Nyquist published his paper. The use of this calculus enables the criterion to be derived in a more direct manner than previously. The elegance of the method rests upon the fact that the criterion of stability of response of a system may be deduced for a comparatively simple input, namely, a unit step function, the criterion being then given complete generality by the proof that the stability of response to unit step function is a sufficient condition for the stability of response to any bounded input.

MS accepted by the Editor, May 1956

1. Condition of Stability in Terms of Poles of Network Transfer Function

Consider a linear lumped-constant network whose transfer function will be denoted by $F(s)$

$X(s) = \int_0^\infty \exp.\ (-st)x(t)dt$ and is written $\mathcal{L}\{x(t)\}$

$Y(s) = \int_0^\infty \exp.\ (-st)y(t)dt$ and is written $\mathcal{L}\{y(t)\}$

$F(s)$ is defined by Equ. (1).

$$X(s)F(s) = Y(s) \quad .. \quad .. \quad .. \quad (1)$$

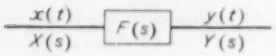

Fig. 1. *Linear lumped-constant network.*

Simple network theory shows[7] that any linear, lumped-constant network, containing active and passive elements, has a transfer function which is a rational function of s.

Accordingly we will write

$$F(s) = \frac{\prod_{\phi=1}^{n}(s - z_\phi)^\beta}{\prod_{\lambda=1}^{m}(s - p_\lambda)^\alpha} \quad .. \quad .. \quad .. \quad (2)$$

where $\alpha = r_\lambda$ the order of the pole of $F(s)$ at $s = p_\lambda$ and $\beta = r_\phi$ the order of the zero of $F(s)$ at $s = z_\phi$. It follows that the degree of the numerator of $F(s)$ is $\sum_{\phi=1}^{n} r_\phi$ and that of the denominator of $F(s)$ is $\sum_{\lambda=1}^{m} r_\lambda$.

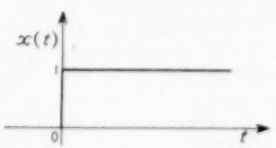

Fig. 2. *Unit-step function.*

Let us consider the response $\{\mathcal{L}^{-1}[Y(s)]\}$ of the network to an input $X(s) = 1/s$; that is, to a unit step applied at $t = 0$ (Fig. 2).

From Equs. (1) and (2)

$$Y(s) = \frac{1}{s}\frac{K\prod_{\phi=1}^{n}(s - z_\phi)^\beta}{\prod_{\lambda=1}^{m}(s - p_\lambda)^\alpha} \quad .. \quad .. \quad (3)$$

In order to evaluate $\mathcal{L}^{-1}\{Y(s)\}$ we will expand $Y(s)$ in partial fractions.

Now the partial fraction expansion of $\frac{1}{(s - p_\lambda)^\alpha}$ is given by

$$\frac{1}{(s - p_\lambda)^\alpha} = \sum_{k=1}^{\alpha}\frac{a_k}{(s - p_\lambda)^k}$$

Hence the complete partial fraction expansion of $Y(s)$ may be written as

$$Y(s) = \frac{a_0}{s} + \sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha}\frac{a_{\nu\lambda}}{(s - p_\lambda)^\nu} \quad .. \quad (4)$$

Where $\nu = k$ if $p_\lambda \neq 0$

$\nu = k + 1$ if $p_\lambda = 0$

On inverting $Y(s)$ we obtain

$$y(t) = \mathcal{L}^{-1}\{Y(s)\} = a_0 + \sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha}\frac{a_{\nu\lambda}\, t^{\nu-1}\exp.\ (p_\lambda t)}{(\nu - 1)!} \quad .. \quad .. \quad (5)$$

The response $y(t)$ to the step input is defined to be stable if

$$\sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha}\frac{a_{\nu\lambda}\, t^{\nu-1}\exp.\ (p_\lambda t)}{(\nu - 1)!} \to 0 \text{ as } t \to \infty$$

This means that any transient generated within the network, by the application of the step-function input, tends to zero as $t \to \infty$.

Thus for a stable response, $\{y(t)\}$, the necessary and sufficient condition is that every term in the series

$$\sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha}\frac{a_{\nu\lambda}\, t^{\nu-1}\exp.\ (p_\lambda t)}{(\nu - 1)!} \text{ tends to zero as } t \to \infty.$$

Now any term of the form $t^\mu \exp.\ (\rho t) \to 0$ as $t \to \infty$ if and only if $\mathrm{Re.}(\rho) < 0$ for $\mu \geq 0$.

Thus the necessary and sufficient condition for a stable response, $\{y(t)\}$, to a step-function input is

$\mathrm{Re.}\ (p_\lambda) < 0$

$\lambda = 1, 2, 3, \ldots . m.$

It is shown, in the Appendix that if $y(t)$ is stable for a step-function input it is also stable for any bounded input.

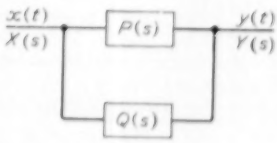

Fig. 3. *Single-loop feedback network.*

2. A Feedback Network

Consider now the feedback network shown in Fig. 3.

Let $P(s)$ and $Q(s)$ be rational functions of s then

$$\{X(s) - Q(s)\ Y(s)\}\,P(s) = Y(s)$$

hence

$$\frac{Y(s)}{X(s)} = \frac{P(s)}{1 + P(s)Q(s)} \quad .. \quad .. \quad (6)$$

By the previous discussion $y(t)$ is stable for $X(s) = 1/s$ if and only if $\frac{P(s)}{1 + P(s)Q(s)}$ has no poles with non-negative real parts.

Poles of $\dfrac{P(s)}{1 + P(s)Q(s)}$ occur when

(1) $1 + P(s)Q(s) = 0$.

This condition may be satisfied with

(a) $P(s)$ and $Q(s)$ both finite,

(b) $P(s)$ a pole of order ψ and $Q(s)$ a zero of order ψ,

(c) $P(s)$ a zero of order γ and $Q(s)$ a pole of order γ, if the resulting order of the zero of $\{1 + P(s)Q(s)\}$ is greater than γ.

(2) $P(s)$ has a pole, if

(a) $\{1 + P(s)Q(s)\}$ finite at the s for which $P(s)$ has a pole,

(b) $P(s)Q(s)$ has a pole of smaller order than the pole of $P(s)$. This can occur if, and only if, $Q(s)$ has at least a simple zero at the s for which $P(s)$ has a pole.

If $P(s)$ and $Q(s)$ have no zeros for finite s in the positive half s-plane, then the necessary and sufficient condition for a pole of $\dfrac{P(s)}{1 + P(s)Q(s)}$ is that $\{1 + P(s)Q(s)\} = 0$ with $P(s)$ and $Q(s)$ both finite.

Let us denote $P(s)Q(s)$ by $G(s)$.

3. Geometrical Interpretation

In order to determine the nature of the zeros of $\{1 + G(s)\}$, consider the following theorem[8].

If $f(z)$ is a function of the complex variable $z = x + jy$ and is meromorphic inside a closed contour C, and is not zero or infinity at any point on the contour, then

$$\frac{1}{2\pi j}\int_C \frac{f'(z)dz}{f(z)} = N - P \qquad .. \qquad .. \qquad (7)$$

where

N = Number of zeros of $f(z)$ within C

P = Number of poles of $f(z)$ within C

A $\left\{\begin{matrix}\text{zero}\\\text{pole}\end{matrix}\right\}$ of order r being counted as $r\left\{\begin{matrix}\text{zeros}\\\text{poles}\end{matrix}\right\}$.

The contour C is traced in an anti-clockwise direction.

If we let $f(z) = W$, Equ. (7) becomes

$$\frac{1}{2\pi j}\int_\Gamma \frac{dW}{W} = N - P \qquad .. \qquad .. \qquad (8)$$

Where the contour C in the z-plane is mapped into the contour Γ in the W-plane by the transformation $W = f(z)$.

W may be written $W = R \exp.(j\theta)$

Substituting this in Equ. (8) we obtain

$$\frac{1}{2\pi}\int_\Gamma d\theta = N - P \qquad .. \qquad .. \qquad (9)$$

$f(z)$ being a continuous function of $(x + jy)$

$$\int_\Gamma d\theta = 2\pi(N - P)$$

= the change in argument of $f(z)$ as the contour C is traced once in the counter-clockwise direction.

This means that the vector $f(z)$ makes $(N - P)$ counter-clockwise revolutions about the origin, as the contour C is traced once in the counter-clockwise direction.

Consider the semi-circular contour ζ in the s-plane as shown in Fig. 4.

The radius R is chosen so that ζ encloses all the poles and zeros of $\{1 + G(s)\}$ in the positive half of the s-plane. Since $\{1 + G(s)\}$ is a rational function of s, $\{1 + G(s)\}$ has a finite number of poles and zeros and a contour can be chosen to enclose all poles and zeros in the positive half s-plane.

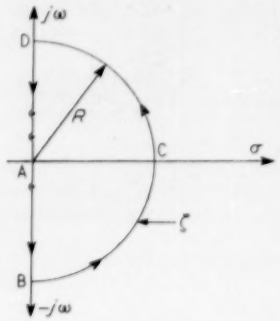

Fig. 4. *Contour enclosing all poles and zeros of $[1 + G(s)]$ in the positive half s-plane.*

If $\{1 + G(s)\}$ has poles and zeros on the imaginary axis the contour, ζ, must be indented into the negative half s-plane in order to enclose such poles and zeros. (Fig. 4.)

By the theorem stated above, it follows that the vector $\{1 + G(s)\}$ makes $(N - P)$ counter-clockwise revolutions about the origin as s makes one counter-clockwise revolution around ζ.

Where N = Number of zeros of $\{1 + G(s)\}$ in the positive half s-plane.

P = Number of poles of $\{1 + G(s)\}$ in the positive half s-plane.

Rotation of $\{1 + G(s)\}$ about the origin is equivalent to the rotation of $G(s)$ about the point $(-1, 0)$ in the same sense.

4. Examination for Stability

The stability of a feedback network may be examined as follows:—

(1) The open-loop transfer function of the network is plotted for ω in the range $\omega = 0$ to ∞; i.e., the locus of the vector $P(j\omega)Q(j\omega)$ is obtained for $\omega = 0$ to ∞.

(2) By taking the mirror image of this locus in the real axis, the locus for ω in the range $\omega = 0$ to $-\infty$ is obtained.

(3) In order to determine the locus of $P(s)Q(s)$ on the portion BCD of the contour ζ, Fig. 4, the form of $P(s)Q(s)$ as $s \to \infty$ is examined. Since $P(s)$ and $Q(s)$ are rational functions of s, $P(s)Q(s)$ may be expressed as the ratio of two polynomials in s. If the degree of the numerator of $P(s)Q(s)$ is n and the degree of its denominator is d then as $s \to \infty$

$$P(s)Q(s) \rightarrow \begin{cases} 0 \text{ if } d > n \\ \infty \text{ if } n > d \\ K \text{ if } n = d \ K \text{ being a constant.} \end{cases}$$

If $n > d$ the locus of $P(s)Q(s)$, when s is on the portion BCD of the contour, ζ degenerates to a point.

If $n < d$, the locus of $P(s)Q(s)$, when s is on the portion BCD of the contour, ζ is given by KR^{n-d} exp. $\{(n-d)j\theta\}$ since $s = R.\text{exp.}(j\theta)$; $-\pi/2 \leq \theta \leq \pi/2$ on the portion BCD of the contour ζ. Thus the locus of $P(s)Q(s)$, makes $\dfrac{n-d}{2}$ counter-clockwise revolutions about the origin as the portion BCD of the contour ζ is traversed.

The necessary and sufficient condition for the stability of $y(t)$ is that the vector, $\{P(s)Q(s)\}$, make P revolutions around $(-1, 0)$ in the positive sense as the contour ζ is traversed once in the negative sense.

5. Discussion

In this section, the assumptions which have been made in the analysis will be considered in more detail.

(1) In order to examine a system for stability using the method described in the paper, it is necessary that both $P(s)$ and $Q(s)$ have no zeros in the finite part of the positive half s-plane. This means that there is no finite frequency at which either $P(j\omega)$ or $Q(j\omega)$ produce infinite attenuation. In any practical system this condition is always satisfied.

(2) The statement that a contour ζ can be chosen to enclose all the poles and zeros of $\{1 + G(s)\}$ in the positive half s-plane requires that $\{1 + G(s)\}$ shall have no poles or zeros at $|s| = \infty$.

(a) Poles of $\{1 + G(s)\}$ at $|s| = \infty$

If $\{1 + G(s)\}$ has a pole at $s = s_0$ then $G(s)$ has a pole at $s = s_0$.

$G(s)$ is defined by the equation $G(s)\,X(s) = Y(s)$ where $X(s) = \mathcal{L}\{\text{Input to Network}\} = \mathcal{L}\{x(t)\}$ and $Y(s) = \mathcal{L}\{\text{Output of Network}\} = \{\mathcal{L}\,y(t)\}$.

In order that $Y(s)$ exist,

i.e. that $\int_0^\infty \text{exp.}(-st)y(t)dt$ converges, it is necessary and sufficient that

$$\frac{G(s)}{s} \rightarrow 0 \text{ as } |s| \rightarrow \infty$$

$\therefore G(s) \rightarrow$ Constant, or Zero as $|s| \rightarrow \infty$

since $G(s)$ is a rational function of s.

Thus $G(s)$ and therefore $\{1 + G(s)\}$ has not a pole at infinity. Similarly $P(s)$ and $Q(s)$ have not poles at infinity.

(b) Zeros of $\{1 + G(s)\}$ at $|s| = \infty$

If $G(s) \rightarrow 0$ as $s \rightarrow \infty$ then $\{1 + G(s)\} \rightarrow 1$.

If $G(s) \rightarrow -1$ as $s \rightarrow \infty$ then $\{1 + G(s)\} \rightarrow 0$; that is, $\{1 + G(s)\}$ has a zero at infinity.

If $\{1 + G(s)\}$ has a zero at infinity then $\left\{\dfrac{P(s)}{1 + G(s)}\right\}$ (i.e., the transfer function of the feedback network) has a pole at infinity.

Since $\left\{\dfrac{P(s)}{1 + G(s)}\right\}$ is a rational function of s it follows from (a) that $\left\{\dfrac{P(s)}{1 + G(s)}\right\}$ cannot have a pole at infinity.

Hence $\{1 + G(s)\}$ cannot have a zero at infinity.

Thus a contour, ζ, may be drawn to enclose all the poles and zeros of $\{1 + G(s)\}$ in the positive half s-plane.

The transfer function of any practical network falls to zero as frequency tends to infinity. Thus $\{1 + G(s)\} \rightarrow 1$ as $|s| \rightarrow \infty$ and therefore $\dfrac{G(s)}{s} \rightarrow 0$ as $s \rightarrow \infty$. Thus, in any practical network, $Y(s)$ exists.

6. Conclusions

(1) *Non-Zero Initial Conditions*

The analysis in this paper has assumed initial conditions of the network to be zero. That the existence of non-zero initial conditions does not modify the criterion of stability may be seen from the following argument:—

It is shown (in Appendix) that, with zero initial conditions, a network which has a stable response to a step-function input has a stable response for any bounded input. Consider such a network. At $t = 0$ let a bounded input be applied to the network, initial conditions being zero; the form of this input being such that after a time t_0 the conditions in the network constitute a desired set of initial conditions. At the instant t_0 let the bounded input be reduced to zero and a second bounded input applied. The input to the system from $t = 0$ to $t \rightarrow \infty$ is a bounded input. Thus the response is stable, by definition. Hence the response between $t = t_0$ and ∞ is stable.

(2) *Multiloop Feedback Networks*

In deriving the criterion, it has been assumed that the networks $P(s)$ and $Q(s)$ were not themselves feedback networks. However, the criterion can still be applied when either or both of the networks are feedback networks.

For example:—

Suppose $P(s)$ is an unstable feedback network, and $Q(s)$ is a non-feedback network. Let us examine the stability of the feedback network shown in Fig. 5. Let $P(s)$ be represented by the feedback network shown in Fig. 6.

$$P(s) = \frac{l(s)}{1 + l(s)m(s)}$$

The transfer function of the feedback network shown in Fig. 5 is:—

$$\frac{P(s)}{1 + P(s)Q(s)} = \frac{l(s)}{1 + l(s)\{Q(s) + m(s)\}}$$

Thus, in order to examine this network for stability, the locus of $l(s)\{Q(s) + m(s)\}$ is obtained in the normal way.

More complicated feedback systems may be broken down and examined for stability in a similar manner.

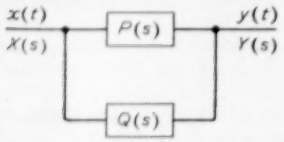

Fig. 5. *Unstable feedback network $P(s)$ stabilized by auxiliary loop.*

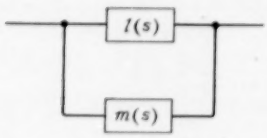

Fig. 6. *Feedback network $P(s)$.*

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APPENDIX

System Stability for any Bounded Input

Theorem

If $F(t)$ and $G(t)$ have absolutely convergent Laplace transforms $f(s)$ and $g(s)$ respectively, then $f(s)g(s)$ is the Laplace transform of the function:—

$$\int_0^t F(\tau)G(t-\tau)d\tau \text{ or } \int_0^t F(t-\tau)G(\tau)d\tau.$$

It has been shown that the response $y(t)$ of a system to a step-function input is stable if the transfer function $F(s)$ of the system has no poles with non-negative real parts. We require to prove that this condition is sufficient for the stability of response to any bounded input.

Proof

Let $F(s)$ be the transfer function of the system

Then $Y(s) = F(s)X(s)$

where $Y(s)$ and $X(s)$ are defined at the beginning of the paper.

The response to a unit step function input; $X(s) = 1/s$ is $h(s)$ given by

$$h(s) = 1/s \,.\, F(s).$$

$$\therefore F(s) = sh(s) \quad .. \quad .. \quad .. \quad .. \quad (1)$$

where $\mathcal{L}^{-1}\{h(s)\} = y(t)$

$y(t)$ being stable by definition and given by

$$y(t) = a_0 + \sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha} \frac{a_{v\lambda}t^{v-1}\exp.\{p_\lambda t\}}{(v-1)!}$$

where $v = k$ if $p_\lambda \neq 0$

$v = (k+1)$ if $p_\lambda = 0$

with Re. $(p_\lambda) < 0$

$\lambda = 1, 2, 3, \ldots . m.$

Now $Y(s) = F(s)X(s)$

$= sh(s)X(s)$ from 1

$\mathcal{L}^{-1}\{sh(s)X(s)\} = g(t)$

where $\mathcal{L}\{g(t)\} = Y(s)$.

$g(t)$ being therefore the response of the system to an arbitrary input $\mathcal{L}^{-1}\{X(s)\}$

$$\therefore g(t) = \frac{d}{dt}\left\{\mathcal{L}^{-1}[h(s)X(s)]\right\}$$

$$= \frac{d}{dt}\left\{\int_0^t y(t-\tau)x(\tau)d\tau\right\}$$

(by the theorem stated above)

$$= \int_0^t y'(t-\tau)x(\tau)d\tau + x(t)y(\tau)\}$$

where $y'(t-\tau) = \frac{d}{dt}\{y(t-\tau)\}$

Now

$y(t)$ and $x(t)$ are bounded functions of t (by definition).

Hence $g(t)$ is bounded if $\int_0^t y'(t-\tau)x(\tau)d\tau$

is bounded.

$$y(t) = a_0 + \sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha} \frac{a_{v\lambda}t^{v-1}\exp.(p_\lambda t)}{(v-1)!}$$

$$\therefore y'(t) = \sum_{\lambda=1}^{m}\sum_{k=1}^{\alpha} \frac{a_{v\lambda}t^{v-2}\exp.(p_\lambda t)\{p_\lambda t + (v-1)\}}{(v-1)!}$$

In order to show that $\int_0^t x(\tau)y'(t-\tau)d\tau$ is bounded we require to show that

$\int_0^t A\,x(\tau)(t-\tau)^k \exp.\{p_\lambda(t-\tau)\}d\tau$ is bounded as $t \to \infty$

Consider the integrand:—

$$|x(\tau)(t-\tau)^k \exp.\{p_\lambda(t-\tau)\}| = |x(\tau)||(t-\tau)^k \exp.\{\sigma_\lambda(t-\tau)\}||\exp.\{j\omega_\lambda(t-\tau)\}|$$

but $|x(t-\tau)| \leq N$.

Since the input is bounded (by definition).

Thus $|x(\tau)||(t-\tau)^k \exp.\{\sigma_\lambda(t-\tau)\}| \leq N|(t-\tau)^k \exp.\{\sigma_\lambda(t-\tau)\}|$.

Now $\left|\int U(\tau)d\tau\right| \leq \int \left|U(\tau)\right| d\tau.$

Thus $\left|\int_0^t A\,x(t)(t-\tau)^k \exp.\{p_\lambda(t-\tau)\}d\tau\right| \leq \int_0^t NA\,|(t-\tau)^k$

$\exp.\{\sigma_\lambda(t-\tau)\}|\,d\tau = N\left|A\right|\int_0^t (t-\tau)^k \exp.\{\sigma_\lambda(t-\tau)\}\,d\tau.$

Since the integrand is essentially positive.

But $\int_0^t (t-\tau)^k \exp.\{\sigma_\lambda\,(t-\tau)\}d\tau$ tends to a constant as $t \to \infty$ for all $\sigma_\lambda < 0$.

Since all σ_λ terms are negative (by definition) the theorem is established.

N-TERMINAL NETWORKS

Some Theorems with Applications to the Directive Properties of Aerial Arrays

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(Communication from the Staff of the Research Laboratories of The General Electric Company Limited, Wembley, England)

Introduction

PART I of the paper gives some basic theorems (required for Part II) which are generalizations of the corresponding theorems for 2-terminal networks. For this reason it is quite possible that they are not new, though the author is at a loss to give (Theorem I excepted) any reference for them.

Part II of the paper deals with certain applications of these theorems to aerial arrays which have been adjusted for maximum absorption of power from an incident wave. It is shown by reference to the Travelling Wave Theorem[2] for maximum directivity of such arrays, that one half of the energy extracted by such an array from the incident wave is re-radiated in the forward direction with the maximum directivity of which the array is capable.

If an aerial array has been adjusted so as to transfer the maximum amount of power from a wave into a single load, it will have maximum directivity for transmission in the reverse direction if we replace this load by a generator. By designing a feeder network whose action is especially simple to follow it can be seen that, in this case, the voltages supplied to the elements of the array are those required by the Travelling Wave Theorem. Thus the condition for maximum directivity of an aerial array can be proved by network considerations only.

1. Network Theorems

Theorem I

Every active n-terminal network of linear elements can be replaced—so far as the action on another linear network is concerned—by the inactive network with a voltage source in series with each terminal such that on open circuit the original network and the simulating network are indistinguishable.*

As has been pointed out on another occasion by the author[1] this theorem is really a special case of Helmholtz's Theorem of the Electromotive Surface and follows from the superposition theorem. Let us insert (Fig. 1) into each terminal lead of the original network a pair of voltage sources which mutually cancel (say, for the ith lead $-E_i$ and $+E_i$). Now, if we open-circuit the network at A′, B′, C′ . . . N′ we see certain open-circuit voltages (measured against some suitable reference point) of amount $E^{(o)}{}_1$ $E^{(o)}{}_2$, . . . $E^{(o)}{}_n$. If we choose $E_1 = +E^{(o)}{}_1$, . . . $E_n = +E^{(o)}{}_n$ it follows that $E^{(o)}{}_1 - E_1 = 0$ . . . $E^{(o)}{}_2 - E_2 = 0$, . . . and so on; i.e., if we remake the connections at A′ . . . N′ and now open-circuit at A . . . N we see a network with zero open-circuit voltages. But, as the voltage sources which we inserted are supposed to have zero internal impedance, all the impedances seen from the various terminals have remained unchanged. This means that, seen from these terminals, the network which we have obtained is indistinguishable from the inactive counterpart of the original network. Hence we are permitted to substitute this inactive network to the left of terminals A . . . N.

If we now remake the connections at A . . . N we arrive at the arrangement described in the theorem.

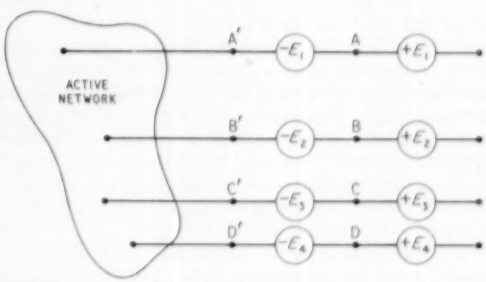

Fig. 1. *Helmholtz's make and break theorem for n-terminal network.*

Theorem II

Every active n-terminal network consisting of linear elements can be replaced—so far as the action on another linear network is concerned—by the inactive network, provided we place across the terminals a sufficient number of current generators such that on short circuit the original network and the simulating network are indistinguishable.

The proof of this theorem is similar to that of Theorem I. The system will be unaffected if we place across any pair of terminals a pair of current generators of equal magnitude and opposite sign

* The active network is supposed to owe its activity to ideal voltage or current sources. The inactive network is obtained from the active network by replacing every voltage source contained therein by a short circuit and every current source by an open circuit.

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(in parallel to each other). We shall now apply a whole system of such current generator-pairs in the following way:

First, we inactivate the network from the point of view of the load by applying short-circuiting straps across a sufficient number of terminals. By doing this we reduce the voltages across any pair of relevant terminals to zero but, of course, we also destroy completely the impedance relations seen by the load across these terminals. However, if we now substitute for each of these short-circuiting straps a current generator carrying exactly the same current as was flowing in the short circuit, then we have still the same current distribution that led to the disappearance of the terminal voltages; but we have also—on account of the infinite impedance of these current generators—restored the original impedance relations. Let us call the set of current generators thus introduced the positive set. We parallel now each current generator by another one carrying exactly the same amount of current in the other direction. These current generators form the negative set. The application of the positive set made the active network as seen from the load indistinguishable from the inactive network; the application of the negative set restores the original activity and, indeed, if we now short-circuit the active network it is seen immediately that these current generators will supply currents of the correct amount and direction.

The two procedures—insertion of series voltage generators or parallel-current generators can be used in a suitable mixed fashion to convert the active network into an inactive network. The subsequent application of the corresponding set of cancelling generators will then lead to the appropriate equivalent circuit. The following should be noted:

(a) Corresponding to the choice of voltage-reference point different voltages will be required for these voltage sources.

(b) Different sets of straps can be applied for short circuiting, leading to different sets of current generators (e.g., in the case of a 3-terminal network we can apply short circuits either between terminals 1–2 and 2–3, or between 2–3 and 3–1)*.

(c) If the equivalent circuit is required only from the point of view of a specific load—or a specific group of loads—it may not be necessary to apply a full set of cancelling generators; hence it may be possible to fulfil specific requirements with equivalent circuits of a simpler kind. A trivial example is the case where certain terminals of the active network are never used by the groups of loads considered. Less trivial is the case where the loads use all terminals but where the nature of the loads forbids currents between certain groups of terminals. In such a case the voltages between that group of terminals (or the short-circuit currents flowing between them) may be ignored. An example is the case of a 4-terminal network with 2-terminal loads that are only capable of connection to terminals 1–2 or 3–4. Any potentials between terminals 1–4 or 2–3 can then be ignored.

*These different sets of generators are, of course, derivable from each other by linear combination.

Conjugate Networks

By a conjugate network we understand a network which is obtained from another network (the 'original' network) by replacing each element of impedance $Z' = R' + jX'$ by an element of impedance $Z'' = Z'^* = R' - jX'$.

It is evident that any impedance or admittance measured between any terminals of the original network is by this process changed to its conjugate value.

Theorem III

Of all inactive loads that can be attached to an active n-terminal network the network forming its conjugate counterpart will extract maximum power.

Using Theorem I the terminal voltages of the active network can be written as

$$E^{(\mathrm{I})}{}_k = E^{(\varphi)}{}_k - \Sigma_n I_n Z_{nk} \quad .. \quad .. \quad (1)$$

where Z_{nk} is the impedance matrix relating the currents I_n from the n terminals of the inactive network to the voltages E_k (measured against the agreed reference point) produced thereby at these terminals.

Multiplying this equation by $I_k{}^*$ and summing over all terminals we obtain the power output as the real part of

$$W = \Sigma_k E^{(\varphi)}{}_k I_k{}^* - \Sigma_k \Sigma_n I_n I_k{}^* Z_{nk} \quad .. \quad (2)$$

The currents I_n in this equation are quite generally determined by the requirement

$$\Sigma_n I_n Z^{(\mathrm{I})}{}_{nk} = E^{(\mathrm{I})}{}_k \quad .. \quad .. \quad (3)$$

where $Z^{(\mathrm{I})}{}_{nk}$ is the impedance matrix of the load between the terminals n and k. In the present case

$$Z^{(\mathrm{I})}{}_{nk} = Z_{nk}{}^* \quad .. \quad .. \quad .. \quad (4)$$

If the currents vary, as the result of load changes, say I_k by δI_k, W varies by δW, and if the theorem is correct, the real part of this variation should be zero. Now

$$\delta W = \Sigma_k E^{(\varphi)}{}_n \delta I_k{}^* - \Sigma_k \Sigma_n Z_{nk} (I_n \delta I_k{}^* + \delta I_n I_k{}^*) \quad .. \quad .. \quad (5)$$

But, as $Z_{nk} = Z_{kn}$ it is seen that n and k are here interchangeable dummy indices and the second term in this equation can be written as $\delta I_k I_n{}^*$. This makes it the conjugate of the first term and the bracket must therefore be real. Any real contribution to the double sum must therefore

come from the real part R_{nk} of Z_{nk}. Hence we can write for the real part δW_r of δW

$$\delta W_r = \mathrm{Re}\Sigma_k E^{(o)}{}_k \delta I_k^* - \mathrm{Re}\Sigma_n \Sigma_k 2R_{nk} I_n \delta I_k^* \quad .. \quad .. \quad (6)$$

But from equations (1), (3) and (4) we can write

$$E^{(o)}{}_k = \Sigma_n I_n (Z_{nk} + Z_{nk}^*) = 2\Sigma_n I_n R_{nk} \; .. \quad (7)$$

Hence equation (6) can be written

$$\delta W_r = \mathrm{Re}\Sigma_k E^{(o)}{}_k \delta I_k^* - \mathrm{Re}\Sigma_k E^{(o)}{}_k \delta I_k^* \; .. \quad (8)$$

which is indeed identically zero for all values $E^{(o)}{}_k$.

As Equ. (7) is an essential stepping stone to Equ. (8) it is seen that the converse theorem, properly formulated must also be true. If an active linear network (impedance matrix Z_{nk}) delivers maximum power into a load, the currents in this condition being denoted by I_n, then the impedance matrix $Z^{(l)}{}_{nk}$ of this load must be such that when 'tested' with these currents it cannot be distinguished from Z_{nk}^*, i.e.,

$$\Sigma_n I_n Z^{(l)}{}_{nk} = \Sigma_n I_n Z_{nk}^* \; (n = 1, 2 \; . \; . \; . \; N) \quad (9)$$

If Equ. (9) is to hold for all possible sets of currents I_n (i.e., all possible sets of voltages $E^{(o)}{}_n$) then

$$Z^{(l)}{}_{nk} = Z_{nk}^*.$$

For a single set of currents I_n arising from a single set of voltages $E^{(o)}{}_n$ Equ. (9) leaves considerable freedom for $Z^{(l)}{}_{nk}$. A case of special interest is that where we impose the additional condition that the matrix $Z^{(l)}{}_{nk}$ only contains diagonal elements; this leads to the so-called 'driving point impedances' discussed in the following Section.

Driving Point Impedance and Equivalent Two-Terminal Loading

Quite often the terminals of the multi-terminal network can be grouped in pairs (for convenience, say, n pairs) so that the members of each pair carry equal but opposite currents. If such a network is connected to other networks through a corresponding number of transmission lines we may ask, what are the impedances which the multi-terminal network offers to these transmission lines?

These impedances are commonly called the driving-point impedances and their inverse the driving-point admittances. Their values are given by

$$Z^{(d)}{}_k = \frac{E_k}{I_k} = \frac{\Sigma I_l Z_{lk}}{I_k} \quad .. \quad .. \quad (10)$$

$$Y^{(d)}{}_k = \frac{I_k}{E_k} = \frac{\Sigma E_l Y_{lk}}{E_k} \quad .. \quad .. \quad (11)$$

where the values I_l and E_l are the currents and voltages appearing at terminal pair i.

It will be noted that $Z^{(d)}{}_k$ and $Y^{(d)}{}_k$ are not constants of the multi-terminal network but depend on the values of I_l or E_l. Thus, for instance, even a purely resistive network with an admittance matrix $[G_{lk}]$ will lead to complex values of $Y^{(d)}{}_k$ if the values of E_l are not all in phase with E_k.

In order to provide optimum loading for a multi-terminal network according to Theorem III we have to use as load another multi-terminal network which is the conjugate of the first network. It is possible to replace this network by 2-terminal networks (one for each pair of terminals) provided these 2-terminal networks carry the same currents as the network they are going to replace. This will be the case if the input admittance of each 2-terminal network is equal to the corresponding driving point admittance of the conjugate network. For a set of open-circuit voltages $E^{(o)}{}_l$ and a purely resistive matrix G_{lk} this leads to the equivalent 2-terminal admittances

$$Y^{(d)}{}_k = \frac{\Sigma E^{(o)}{}_l G_{lk}}{E^{(o)}{}_k} \quad .. \quad .. \quad .. \quad (12)$$

as with this particular load, all the terminal voltages E_l, E_k will be exactly one half of the original open-circuit voltages $E^{(o)}{}_l$. The left-hand side of the equation will change to its conjugate value if the values $E^{(o)}{}_l$, $E^{(o)}{}_k$ are replaced by their conjugate counterparts.

PART II

Application to Absorption, Re-Radiation and Directive Properties of Aerial Arrays

A plane electromagnetic wave transports through each unit area of its wave front a certain amount of power; if an aerial is provided to receive it we can give an indication of the amount of power extracted from the wave by quoting the cross-sectional area of the wave-front through which this power has passed. This area is called the absorption area of the aerial and its magnitude depends evidently on the loading of the aerial. If the aerial is optimally loaded in the sense used in Part I, it will have its maximum absorption area.

From the point of view of the theorems of Part I, an aerial array constitutes an n-pair terminal network in which the terminal currents and voltages are related by an impedance matrix

$$[Z_{lk}] = [R_{lk} + jX_{lk}]$$

The optimum load for this aerial array consists therefore of a network with an impedance matrix

$$[Z'_{lk}] = [Z^*_{lk}] = [R_{lk} - jX_{lk}] \quad .. \quad (13)$$

It will be noticed that such a load will cause the aerial to have maximum absorption area for any direction of the incident radiation, though the size of this area will, in general, vary with this direction. If $[G_{lk}]$ is the reciprocal matrix to

$[R_{ik}]$ and if the open-circuit voltages of the various aerials are denoted by $E^{(o)}_i$, the power flow into the load and thus the absorption area is determined by

$$W = \tfrac{1}{4}\Sigma\Sigma E^{(o)}_i E^{(o)*}_k G_{ik} \quad .. \quad .. \quad (14)$$

The set of voltages $E^{(o)}_i$ varies, of course, with the direction of the incident radiation.

From the point of view of the load the impedance matrix Z_{ik} represents the internal impedance of the power supply. However, with a lossless aerial, the resistive part of this matrix does not correspond to an actual dissipation of electrical energy into heat; it corresponds in this case to energy that is re-radiated from the aerial.

It should be noted that this energy is re-radiated according to a polar diagram that is, in general, different from the polar diagram of the array when used in transmission for the very simple reason that the current distribution in both cases need not necessarily be the same*.

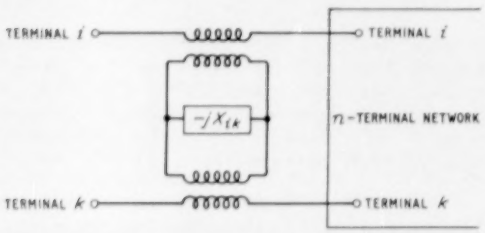

Fig. 2. *Network for cancellation of mutual reactance* $+jX_{ik}$.

Now, the Travelling Wave Theorem for maximum directivity of aerial arrays states[2] that in order to radiate with maximum directivity we have to arrange on the array a current distribution as follows:—The 'resistance voltages' at the individual elements of the array (that is those components of the terminal voltages which are related to the currents in the array by disregarding the reactive parts of the impedance matrix) must vary over the elements of the array as if they were the field-strength values at each element position of a plane electromagnetic wave travelling across the array in the direction in which the array is intended to transmit. In symbols: if $E^{(o)}_i$ denotes the open-circuit voltage defined by the travelling wave then the currents I_i are given by the equations

$$\Sigma_k I_k R_{ik} = E^{(o)}_i \quad .. \quad .. \quad .. \quad (15)$$

We have quoted here the Travelling Wave Theorem, as formulated in reference 2, for arrays consisting of identical elements in identical orientation and we recognize immediately that we would have obtained the same current distribution if we had a real wave travelling across the array (producing at each element an open-circuit voltage equal to twice its ascribed resistance voltage) and if the array had been loaded with its conjugate counterpart:—

$$\Sigma_k I_k (Z_{ik} + Z_{ik}^*) = 2\Sigma I_i R_{ik} = 2E^{(o)}_i \quad .. \quad (16)$$

Hence it can be stated immediately, that in the case of such an array, re-radiation will take place with maximum directivity in the direction in which the original wave train was travelling.

We shall use the last part of the paper to give an independent proof of the Travelling Wave Theorem. It follows from reciprocity that the power gain of an aerial is the same for transmission and reception. Hence, if the feeders of an aerial array are adjusted so as to deliver maximum power from a distant transmitter into a single load, this same aerial will have maximum power gain for transmission in the opposite direction when we replace this load by a generator. By constructing a feeder network that is particularly simple to follow in its action we shall find—by inspection—that the current distribution in the transmitting case is indeed the distribution specified by the Travelling Wave Theorem. In reference 2, the case of non-identical elements has also been dealt with by a slightly modified form of the Travelling Wave Theorem. However, it is shown here in Appendix II that the procedure which we have just described covers this more general case. It is of some interest that the condition for maximum directivity of an aerial array can thus be derived by the mere application of network considerations.

As the first step in the construction of the feeder network we arrange that all the reactance terms of the impedance matrix

$$Z_{ik} = R_{ik} + jX_{ik}$$

of the array are cancelled by appropriate additions to the leads going to the terminals of the array. A reactance term like jX_{ii} can be cancelled by inserting into the lead to the ith terminal a reactance $-jX_{ii}$. To cancel a mutual reactance term like jX_{ik} we proceed as shown in Fig. 2. Ideal transformers are inserted into the leads going to terminals i and k and a reactance $-jX_{ik}$ is inserted in shunt.

After these modifications have been carried out, the array offers from its new terminals an impedance matrix $[R_{ik}]$. It will also be noted that the open-circuit voltages $E^{(o)}_i$ that appear on these new terminals are the same as those that appeared across the old terminals of the array.

To adjust the array for maximum absorption we shall have to load the new terminals with an n-terminal network of impedance matrix $[R_{ik}]$.

* The current distribution in both cases can differ, as the mode of excitation differs. This has been known for individual aerials for some time [3, 4, 5, 6, 7] and will be discussed further in Appendix I. The validity of the reciprocity theorem is in no way affected. This theorem is only concerned with currents and voltages at the final aerial terminals and not with the ratios of currents, measured at some intermediate positions.

By doing so the voltages at the various new terminals will change to 1/2 their original open-circuit values. As the next step, however, we replace this load by a set of equivalent 2-terminal networks (see Equ. 10, Part I) each consisting of a resistance R'_k and (in general) a reactance X'_k in parallel. The resistance part of such an aerial load can be separated from the reactance part by a lossless transmission line of a characteristic impedance equal to that resistance. This leaves the amplitudes of current and voltage at the resistance unchanged but delays their phase by an angle that corresponds to the electrical length of the transmission line. By using lines of suitable length we can thus arrange that the voltages across all load resistances are in phase. We can then replace all these resistances by ideal transformers of suitable turns ratios, the secondaries of which are all joined in parallel and supply a single load resistor R_L. The procedure is illustrated in Fig. 3. Here we have assumed a wave coming from the right, making the phase angles of the open-circuit voltages of the various aerials equal to $\alpha_1, \alpha_2 \ldots \alpha_n$ (in increasing order). By adding transmission lines of length $\beta_\ell = \text{const.} - \alpha_\ell$ all outputs have been brought into coincident phase and it will be noted that the voltage across each load resistance; i.e., across each primary of the ideal transformers is equal to 1/2 of the original open-circuit voltage of each aerial.

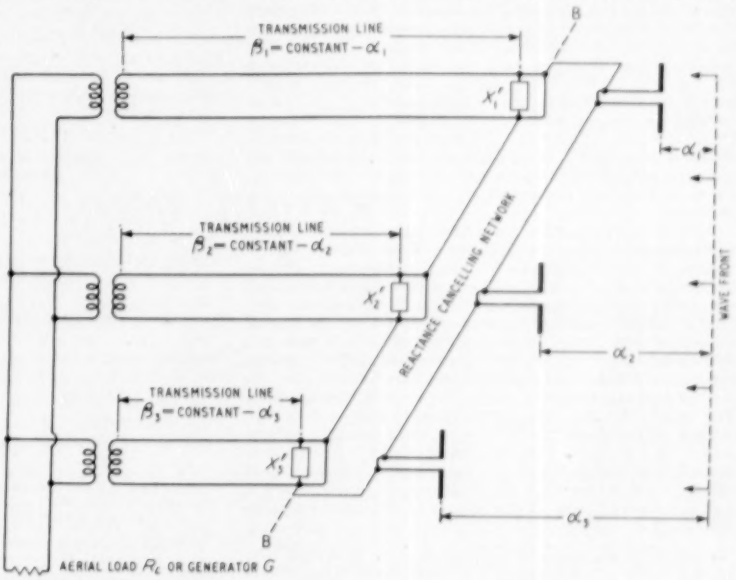

Fig. 3. *Derivation of the travelling-wave theorem for maximum directivity.*

We now replace the final load R_L by a generator G to which, for simplicity, we give twice the voltage that previously appeared across R_L. This means that at the left-hand end of each transmission line a voltage appears equal in magnitude and phase to the original open-circuit voltage of each aerial. We assert that these voltages $(E^{(o)}_\ell)$ will appear in equal amplitude but suitably delayed at the right-hand end of the various transmission lines, corresponding to a wave that is now progressing from the left to the right; thus, the excitation applied to the elements of the array will be exactly as required by the Travelling Wave Theorem for maximum transmission in the direction from which the original wave came, for we have then for the array

$$\Sigma_k I_k R_{\ell k} = (E^{(o)}_\ell) \quad \ldots \quad \ldots \quad \ldots \quad (17)$$

This result will be obvious if we can show that the transmission lines are all properly terminated at their right-hand ends.

Now, the loading of these transmission lines consists of the reactance parts X'_ℓ of the original equivalent load, together with the combined aerial array and reactance-cancellation network to the right-hand side of the boundary lines B – B of Fig. 3; the latter combination has an input impedance matrix $[R_{\ell k}]$. Using Equ. (10) of Part I we will replace this combination (not including the reactances X'_ℓ) by an equivalent set of 2-terminal networks, each consisting of a resistance R_ℓ'' and a reactance X_ℓ'' in parallel. If our assertion is correct (i.e., if the transmission lines behave as if they were properly terminated) then the voltages $(E^{(o)}_\ell)$ that appear at the right-hand end of these lines will be the complex conjugates of the original open-circuit voltage $E^{(o)}_\ell$ that were used, in combination with Equ. (12) to derive the values of R_ℓ' and X_ℓ'. Hence the concluding remark of Part I applies and we have

$$R_\ell'' = R_\ell' \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (18)$$

$$X_\ell'' = -X_\ell' \quad \ldots \quad \ldots \quad \ldots \quad (19)$$

This means that the reactances at the load end cancel and the resistances are of the magnitude required for the correct termination of the transmission lines.

APPENDIX I

The Current Distribution in Aerial Arrays for Reception and Transmission

That the current distribution in the receiving case will, in general, differ from the current distribution in the transmitting case can be seen as follows:

We cut the connection between the aerials and the feeder network and apply Theorem I. In the receiving case there will then be an equivalent network consisting of the passive aerials and in series with each aerial terminal a voltage generator (voltages $E^{(or)}{}_1$, $E^{(or)}{}_2$ . . . $E^{(or)}{}_n$). If we remake the connection, the excitation supplied by these generators will be responsible for the feeder currents and hence for the currents in the aerials.

To change from reception to transmission we place a generator in series with the final load resistance of the feeder network. Cutting the feeder network from the aerials we can, according to Theorem I, replace it by a passive network which, in this case, is identical with the feeder network as it was used before in the receiving case; in series with each feeder pair is a voltage generator (voltages $E^{(at)}{}_1$, $E^{(at)}{}_2$ . . . $E^{(at)}{}_n$). If we remake the connection we have the same network configuration as in the receiving case, only now with voltages $E^{(at)}{}_t$ instead of $E^{(or)}{}_t$ in the generators. Now, the current distribution in the first case is determined by the impedance matrix that arises from the addition of the impedance matrix $Z^{(a)}{}_{nk}$ of the aerial system and the impedance matrix $Z^{(f)}{}_{nk}$ of the feeder system, together with the ratios of the voltages $E^{(or)}{}_1 : E^{(or)}{}_2 : E^{(or)}{}_3 \ . \ . \ . \ E^{(or)}{}_n$. The current distribution in the second case is determined by the same impedance matrix and by the ratios of the voltages $E^{(at)}{}_1 : E^{(at)}{}_2 : . \ . \ . \ E^{(at)}{}_n$. The first set of these voltage ratios is a property of the aerials only, the second set is a property of the feeder network only. In general, we cannot expect these two sets and the results to be identical.

An alternative and also very instructive way of looking at the same problem is as follows:

Assume the individual elements of the array to be connected to a common feeder network with a 2-terminal output to which we have joined an impedance—the load of the array. Let us place in series with this load a voltage source (E_1) of such strength that it just balances the open-circuit voltage of the network. The current through the load will then be zero but the currents in the individual elements of the array will not be zero. We will call the resultant current distribution the 'idling distribution'*. We now add another voltage source (E_2) in series with the first one which just cancels it and thus brings the array back to its normal loaded state. But source (E_2) by itself causes in the array a current distribution of the shape of the 'transmitting distribution'. Hence the receiving current distribution is obtained by the superposition of the idling current distribution and the transmitting current distribution. Only when these two current distributions have the same shape (i.e., are proportional to each other) will the receiving distribution be of the shape of the transmitting distribution. In general, this cannot be expected and there will then be a corresponding difference between the polar diagrams for re-radiation and transmission.

* This idling distribution is evidently not a property of the array by itself but of the combination 'array + feeder network' and direction of incident wave.

APPENDIX II

The Travelling Wave Theorem for Arrays with Non-Identical Elements

In reference 2 the problem of non-identical aerials was solved as follows:

Let $H = \Sigma h_m I_m e^{j\theta m}$ . . . . . (A1)

the distant field-strength produced by the aerial currents I_m where h_m denotes a suitable (real) factor of proportionality. Introduce modified currents and modified resistances as follows:

$$I^+{}_m = I_m h_m \quad . . \quad . . \quad . . \quad . . \quad . . \quad (A2)$$

$$r^+{}_{lm} = r_{lm}/h_l h_m \quad . . \quad . . \quad . . \quad . . \quad (A3)$$

Assume a constant amplitude $e^{-j\theta}$ of resistance voltage as in the case of identical aerials and solve as before; i.e.,

$$I^+{}_m = \Sigma e^{-j\theta_l} g^+{}_{lm} \quad . . \quad . . \quad . . \quad . . \quad (A4)$$

where $[g^+{}_{lm}]$ is the reciprocal matrix to $[r^+{}_{lm}]$.

To show the equivalence of this procedure to that described in the present text we rewrite (A3) in matrix notation:

$$[r^+{}_{lm}] = [h^{-1}] \, . \, [r_{lm}] \, . \, [h^{-1}] \quad . . \quad . . \quad . . \quad (A5)$$

where $[h^{-1}]$ denotes a diagonal matrix with elements $h^{-1}{}_1 \ . \ . \ . \ h^{-1}{}_l$. From this follows by inversion

$$[g^+{}_{lm}] = [h] \, [g_{lm}] \, [h] \quad . . \quad . . \quad . . \quad . . \quad (A6)$$

or

$$g^+{}_m = g_{lm} h_l h_m \quad . . \quad . . \quad . . \quad . . \quad (A7)$$

Hence (A4) can be written

$$I^+{}_m = I_m h_m = \Sigma e^{-j\theta_l} g_{lm} h_l h_m \quad . . \quad . . \quad (A8)$$

or

$$I_m = \Sigma h_l e^{-j\theta_l} g_{lm} \quad . . \quad . . \quad . . \quad . . \quad (A9)$$

This is, however, also the result of the present procedure as on account of reciprocity the open-circuit voltages of the individual aerials are no longer equal but given by

$$E e^{\prime}{}_{il} = h_l e^{-j\theta_l} \quad . . \quad . . \quad . . \quad . . \quad . . \quad (A10)$$

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CORRESPONDENCE

Letters to the Editor on technical subjects are always welcome. In publishing such communications the Editors do not necessarily endorse any technical or general statements which they may contain.

Standard-Frequency Transmissions—Droitwich 200 kc/s

SIR,—We are rather disturbed to notice that the usual monthly reports on the accuracy of the Droitwich transmitter on 200 kc/s published in *Wireless Engineer* have not been quoted for the months of September and October.

In view of the fact that a large number of instrument manufacturers rely on Droitwich as their main source of frequency calibration, we would be very much obliged to know the reason why the monthly reports appear to have been discontinued.

We might just add that we find Droitwich by far the most useful of all the standard-frequency transmissions in this country, largely because of the high field strength and also because of the very convenient frequency.

M. I. FORSYTH-GRANT

Racal Engineering Ltd.,
Bracknell, Berks.
19th October 1956.

SIR,—When we started publishing results for MSF we decided after consultation with the B.B.C. to include values for Droitwich which we knew to be widely used, although it is not so closely controlled as MSF. There has, however, been no evidence submitted to us that these values serve any useful purpose and it has been suggested that for those applications for which Droitwich is adequate no corrections are necessary. According to our measurements the frequency is usually within ± 5 parts in 10^8, and the value we published, with an accuracy of ± 1 part in 10^8, applied to only a particular time of the day, and was moreover six weeks in retrospect. However, the matter can be reconsidered if a publication in this form is useful and we shall welcome any specific comments on the matter.

You will probably be aware of the difficulty of securing frequency allocations for standard transmissions. We may mention that the closer control of the Droitwich station was considered some years ago but that it was then feared that the frequency would be moved off the round figure which is such a useful feature for standard transmission purposes. This possibility must be borne in mind, as no frequency below 2·5 Mc/s is specifically allocated to such services. Our 60-kc/s MSF transmission remains on an experimental basis.

L. ESSEN

Electricity Division,
National Physical Laboratory,
Teddington, Middlesex.
25th October 1956.

NEW BOOKS

" Wireless World " Diary 1957

80 pages of reference material, and diary pages of one week to an opening. Size $4\frac{1}{4}$ in. $\times$ $3\frac{1}{4}$ in. Published by T. J. & J. Smith in conjunction with *Wireless World*, Dorset House, Stamford Street, London, S.E.1. Price, Leather 6s., Rexine 4s. 3d.

Introduction to Printed Circuits

By ROBERT L. SWIGGETT. Pp. 112. John F. Rider Publisher Inc., 480 Canal Street, New York 13. Price $2.70.

A brief history of printed circuits is followed by descriptions of present-day printed-circuit practice on the part of several U.S. manufacturers.

Picture Book of TV Troubles. Vol. 7—Sound Circuits and Low-Voltage Power Supplies

By JOHN F. RIDER LABORATORIES STAFF. Pp. 64. John F. Rider Publisher Inc., 480 Canal Street, New York 13, U.S.A. Price $1.50.

Some typical U.S. television receiver h.t. supply and sound i.f. amplifier and detector circuits are considered from the viewpoint of the effect of component failures on circuit voltages and waveforms.

Analysis of Bistable Multivibrator Operation

By P. A. NEETESON. Pp. 82. Philips Technical Library. Cleaver Hume Press Ltd., 31 Wright's Lane, Kensington, London, W.8. Price 15s.

The Eccles-Jordan flip-flop circuit is analysed under static and dynamic conditions. Chapters are included on trigger sensitivity, triggering speed, waveforms during the complete trigger cycle, design considerations and variations on the fundamental circuit.

Progress in Semiconductors, Vol. 1

Edited by A. F. Gibson, P. Aigrain and R. E. Burgess. Pp. 220. Heywood & Co. Ltd., Tower House, Southampton Street, London, W.C.2. Price 50s.

This volume contains seven articles, all on the physical aspects of transistors rather than on circuit applications. The individual subjects are: Recent advances in silicon; The germanium filament in semiconductor research; Theory of the Seebeck effect in semiconductors; The electrical properties of phosphors; The design of transistors to operate at high frequencies; Photo-magneto-electric effect in semiconductors and Field effect in semiconductors.

NOBEL PRIZE

Dr. William Shockley shares the 1956 Nobel prize for physics with Dr. John Bardeen and Dr. Walter Hauser Brattain. He is well known for his work on solid-state physics at the Bell Telephone Laboratories which led to the development of the transistor. He recently joined Bechman Instruments Inc., where he is in charge of the semiconductor laboratory.

OBITUARY

James Robinson, M.B.E., D.Sc., Ph.D., M.I.E.E., F.Inst.P., died on 21st October at the age of 72. During the 1914–18 war he served in the R.N.V.R. and R.N.A.S. and he developed the crossed-loop direction-finding system which is known by his name. This was embodied in one of the early R.A.F. homing systems.

He was equally well known for the Stenode Radiostat which aroused a great controversy about the physical reality of sidebands in the early '30s. The stenode embodied a quartz-crystal resonator as a highly-selective circuit in conjunction with an a.f. amplifier having an inverse frequency characteristic over the range of modulation frequencies.

MEETINGS

I.E.E.

10th December. "Unsolved Problems arising from Automation", discussion to be opened by G. L. E. Metz.

12th December. "The B.B.C. Sound Broadcasting Service on Very-High Frequencies", by E. W. Hayes and H. Page, M.Sc.

14th December. "The Teaching of the Fundamentals of Transistor Circuits to Students of Electrical Engineering", discussion to be opened by P. Godfrey, B.Sc.(Eng.), at 6 o'clock.

18th December. "Breakdown in Dielectrics", discussion to be opened by C. G. Garton and J. H. Mason, B.Sc.

These meetings will be held at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2, and will commence at 5.30, except where otherwise stated.

Brit.I.R.E.

12th December. "Principles of the Light Amplifier and Allied Devices", by T. B. Tomlinson, Ph.D., to be held at the London School of Hygiene & Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, at 6.30.

Television Society

7th December. "90° Scanning," by R. H. C. Morgan, B.Sc. and K. E. Martin. To be held at 7 o'clock at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2.

British Kinematograph Society

13th December. "A Magnetic Tape Recording System for Colour Television Signals", by H. R. L. Lamont, Ph.D., M.A., to be held at 7.15 at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

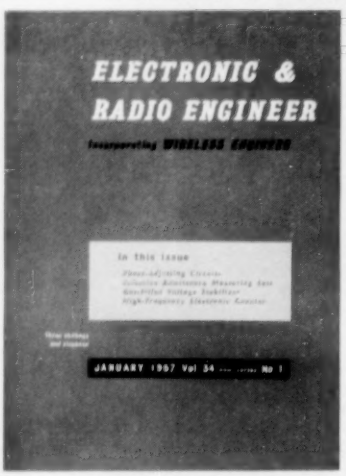
Royal Society of Arts

10th December. "Engineering Electronics (excluding radar and Service equipment)," by L. E. C. Hughes, B.Sc.(Eng.), Ph.D., A.C.G.I., to be held at 6 o'clock at the Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2.

Society of Instrument Technology

"Phase-plane Methods in Control System Design", by G. D. S. MacLellan, M.A., Ph.D., to be held at 7 o'clock at Manson House, Portland Place, London, W.1.

THE NEW "WIRELESS ENGINEER"



With the new title, *Electronic & Radio Engineer*, and a larger page area, the January 1957 issue of this journal will, we feel sure, be welcomed by our readers.

Electronic & Radio Engineer will still contain all the normal features of *Wireless Engineer*. The original scientific papers and Abstracts and References will be there in full measure.

The journal will, however, include an expanded editorial content; and this new material will deal extensively with today's engineering applications of yesterday's research findings in the wider field of electronics generally.

We feel sure that you will find *Electronic & Radio Engineer* of even greater importance in its new form. The price of the journal remains unaltered.

RADIO AND ELECTRONIC COMPONENT SHOW

The 14th annual exhibition organized by the Radio and Electronic Component Manufacturers' Federation is to be held at Grosvenor House and Park Lane House, Park Lane, London, W.1, from Monday to Thursday, 8th–11th April 1957.

STANDARD-FREQUENCY TRANSMISSIONS

(Communication from the National Physical Laboratory)

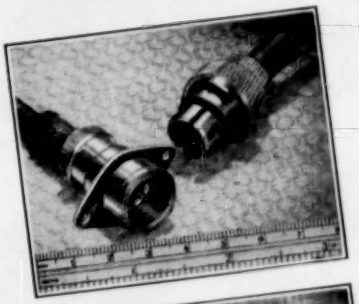
Values for October 1956

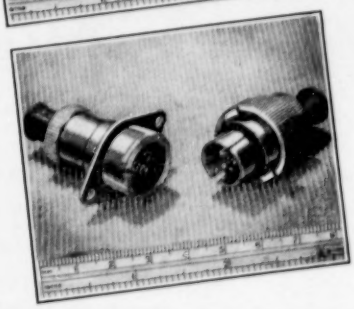
Date 1956 October	MSF 60 kc/s Frequency deviation from nominal*: parts in 10^9
1	0
2	+1
3	+2
4	+1
5	+1
6	N.M.
7	N.M.
8	+1
9	+1
10	+1
11	+1
12	+2
13	+2
14	+2
15	+2
16	+1
17	+2
18	+1
19	+2
20	N.M.
21	N.M.
22	+2
23	+2
24	+2
25	+2
26	+2
27	+3
28	+3
29	+3
30	+2
31	+2

N.M. = Not Measured.

*Nominal frequency is defined to be that frequency corresponding to a value of 9 192 631 830 c/s for the N.P.L. caesium resonator.

"BELLING-LEE" "SCREENECTORS"





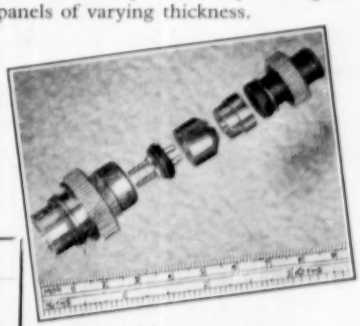
THIS range of lightweight screened connectors was designed to meet the increasing demand for a non-reversible screened twin plug and socket to load cables up to 0.24 in. dia. over the braid. At the same time, the design has been made versatile so that single and multipole contacts may be assembled into the common housing. The appearance of this housing is in keeping with modern instrument finish.

Although a locking ring forms part of the assembly, the screen skirt is resilient, thus maintaining excellent contact should the locking ring be inadvertently left loose.

The contact assembly insulator is produced from a moisture resistant nylon-filled phenolic moulding material, and the design includes lengthened leakage paths between contacts in order to maintain high insulation resistance which is in the order of 60,000 MΩ at 500 volts d.c. between pins, or pins and frame.

Both the connections to the plated contacts are made by soldering to wedge slotted spills, while the screen connection is based upon the well-known split cone method of clamping. A reinforcing rubber sleeve is also included to decrease insulation wear at the point of flexing. The housing is designed so that various applications may be employed, e.g., free plug and fixed socket and vice versa or adaptor bulkhead, all varieties with either one, two or three pins or sockets, and each part interchangeable in its appropriate position in the assembly. The keyed flange permits their use on panels of varying thickness.

These plugs and sockets are suitable for a working voltage of 150 volts d.c. or a.c. peak.



Type	Free Plug	Fixed Socket	Adaptor Bulkhead	Free Socket
Coaxial	**L.788/FP**	**L.788/CS**	**L.788/BS**	**L.788/FS**
2-pole	**L.789/FP**	**L.789/CS**	**L.789/BS**	**L.789/FS**
3-pole	**L.790/FP**	**L.790/CS**	**L.790/BS**	**L.790/FS**

Type	Characteristic impedance in ohms at approx. 1 mc/s.	Capacitance plug and socket rated at approx 1 mc/s.		Contact resistance at 1 amp.
		Conductor/Conductor	Conductor/Screen	
Coaxial	75	—	1·9 pF.	less than 2 milliohms each
2-pole	100	1·4 pF.	2·3 pF.	
3-pole	—	2·0 pF.	2·7 pF.	

L.788/C Protective cover

A dust cover is available for use with these connectors and is supplied complete with chain attachment.

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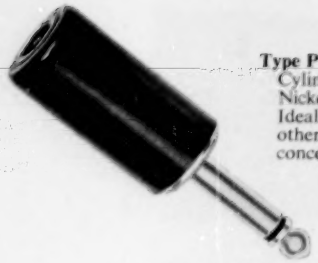
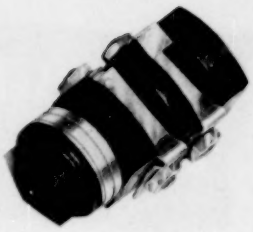


Type P 50 Plug
Cylindrical bakelite case. Nickel plated metal parts. Ideal for amplifiers and other applications where concentric cable is used.

Midget Jack. P 73
Moulded bakelite. Suitable for switching-in high frequency circuits. Capacity between springs eliminated. Silver contacts, one hole fixing, perfect contact.



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Type P 40 Plug
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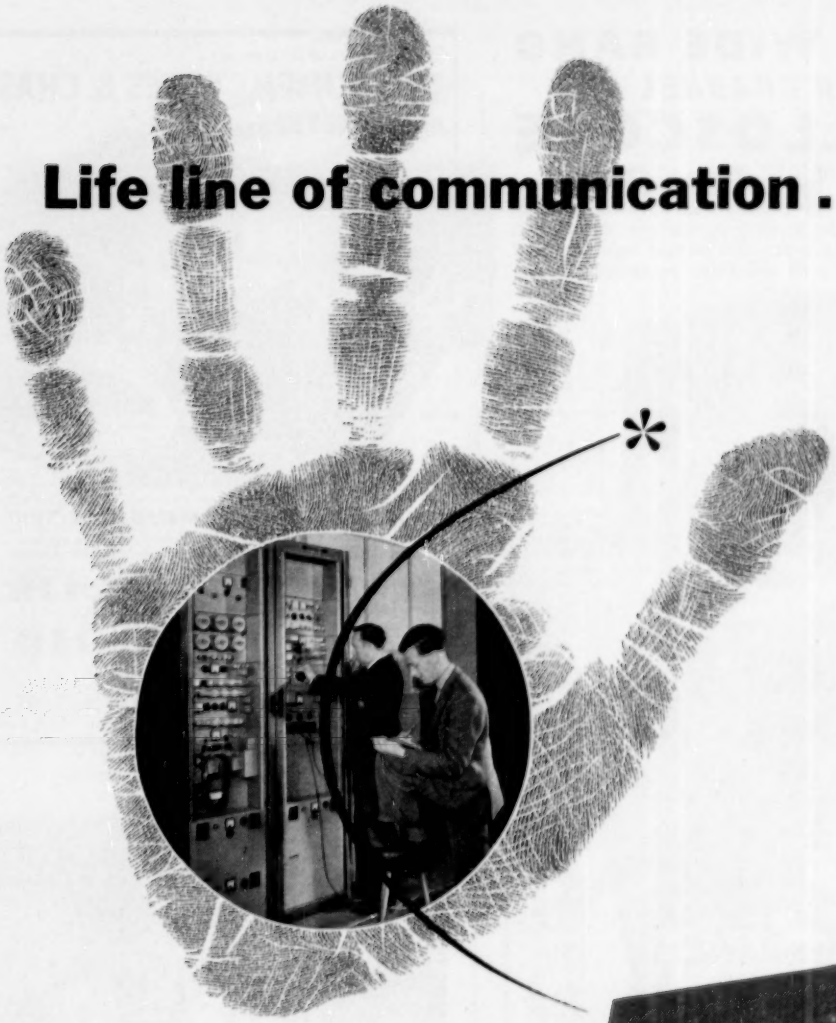

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REPETITIVE sweeps also available.

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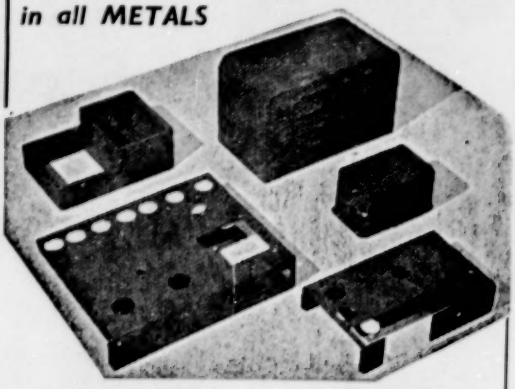

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"VARIAC" GENERAL Classification	CURRENT RATINGS (Amperes)			
	115 v. OPERATION		230 v. OPERATION	
	Rated (0-135 v. Output)	Maximum (0-115 v. Output)	Rated (0-270 v. Output)	Maximum (0-230 v. Output)
200-B	1.0	1.5	—	—
V-2	2.0	3.0	—	—
V-5: V5-H	5.0	7.5	2.0	2.6
V-6: V6H	6.0	7.5	3.0	3.75
V-10: V-10-H	10.0	13.0	4.0	5.2
100Q: 100-R	15.0	17.5	8.0	9.0
V-20: V20H	20.0	26.0	8.0	10.4
V-30-H	—	—	15.0	17.5
50A: 50-B	40.0	45.0	20.0	31.0
M-2	2.0	3.0		
M-5	5.0	7.5	*For use on 350-1200 c/s.*	
M-10	10.0	13.0		
60-V	5.0	7.5	*For use on 400-2600 c/s.*	

This table refers only to single winding toroidally-wound VARIACS *and does not include double wound types (Types 70 and 80) or ganged assemblies, or 3-phase types, etc.*

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Application form and further particulars from Civil Service Commission, Scientific Branch, 30 Old Burlington Street, London, W.1, quoting S128/56 and stating date of birth.

Selection Board sits at intervals, as required.

Early application advised and in any case not later than 31st December 1956.

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Candidates should have passed or be exempt from the examinations of the Institution of Electrical Engineers and have had two years' practical experience in the Engineering Department of the British Post Office or with a large telecommunications equipment manufacturer.

1. **Engineers.** Candidates should preferably possess more than the minimum qualifications above and have wide knowledge and experience of telecommunications practice and administration. Experience of power generation and distribution an advantage. To take charge of a telecommunications engineering district involving responsibility for installation and maintenance of overhead and underground telegraph apparatus.

2. **Wireless Engineers.** Candidates should also have had considerable experience with H.F. and V.H.F. fixed and mobile equipment, and air and sea navigational aids. Experience of power generation and transmission an advantage. To take charge of Wireless Engineering Division or be Assistant to Engineer in charge involving installation and maintenance of medium H.F. and V.H.F. W/T and R/T stations operated by Posts and Telecommunications, Police and Civil Aviation Departments.

3. **Master, Telecommunications Engineering School.** Candidates should also have had five additional years' experience in telecommunications engineering, and some experience of teaching. To be responsible for training of junior technical staff in telecommunications subjects, and to assist Principal of the school in administration and discipline.

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Technology of Cold Cathode Valves:
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Six lectures beginning 28th February 1957.

Enquiries should be addressed to the Head of Department of Physics, Northern Polytechnic, Holloway, N.7. Telephone: NORth 1686.

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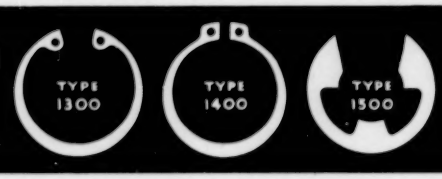

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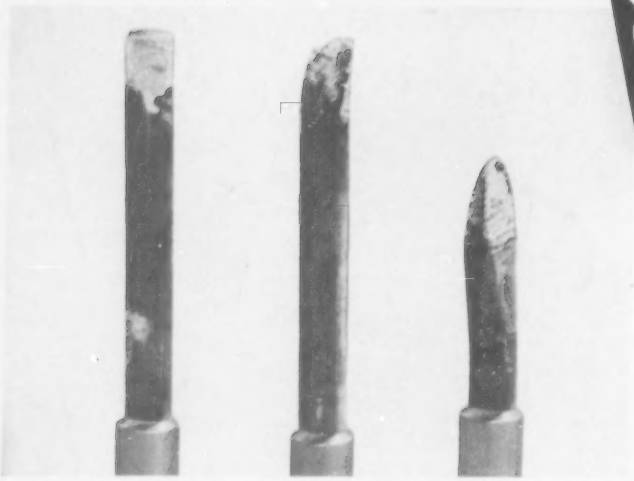

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The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.13 : 534.845 — 1

Wedge-Shaped Cavity Resonators.—E. Kohlsdorf. (*Hochfrequenztech. u. Elektroakust.*, July 1955, Vol. 64, No. 1, pp. 33–34.) A calculation is made of the characteristics of acoustic resonators formed in a hall by the steps and the sloping floor supporting them. The height of the resonator considered is 0·4 m, the depth 0·8 m and the width 1 to 2 m; the front wall is slotted. Maximum absorption occurs near 158 and 365 c/s; this is shown graphically.

534.213.4 — 2

On Webster's Horn Equation.—E. S. Weibel. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 726–727.) "A wave equation for the sound propagation through tubes is derived by means of Hamilton's variational principle. It is assumed that the wave fronts can be approximated by surfaces of constant stream potential; this is the only assumption made. The variational principle ensures that the best equation that is compatible with this assumption will be obtained. The equation has the form of Webster's horn equation, however its coefficients are defined differently."

534.232 — 3

On the Radiation Impedance of an Array of Finite Cylinders.—D. H. Robey. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 706–710.) Analysis is presented for an array of sound sources in the form of collinear cylinders.

534.232 : 546.431.824-31 — 4

On the Radiation Impedance of the Liquid-Filled Squirting Cylinder.—D. H. Robey. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 711–714.) Analysis is presented for the underwater transducer discussed previously (1847 of 1955).

534.24 — 5

Nonspecular Reflection of Sound from a Sinusoidal Surface.—H. S. Heaps. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 698–705.) The reflected field is obtained as the sum of an infinite number of terms whose coefficients may be found from a recurrence relation. The three central terms in the series correspond to the first-order approximation. The results are used to determine the average intensity and fluctuations of the sound reflected from a travelling sinusoidal boundary. The degree of roughness required to destroy the effect of Lloyd's mirror fringes is discussed in terms of the size of the surface corrugations relative to λ.

534.614-8 — 6

Variation of Acoustic Velocity with Temperature in Some Low-Velocity Liquids and Solutions.—G. W. Marks. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 680–688.) Measurements on various organic liquids are reported, using an ultrasonic interferometer and a frequency of 500 kc/s.

534.75 — 7

Some Parameters influencing the Pitch of Amplitude-Modulated Signals.—A. M. Small, Jr. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 751–760.)

534.78 — 8

Effect of Duration on the Perception of Voicing.—P. Denes. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 761–764.) An investigation of factors affecting the recognition of phonemes is described based on the observed differences in the relative durations of the vowels and consonants according as the latter are voiced or unvoiced.

534.78 — 9

Acoustic Loci and Transitional Cues for Consonants.—R. C. Delattre, A. M. Liberman & F. S. Cooper. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 769–773.) Experiments on the synthesis of speech are described.

534.844.5 — 10

Optimum Reverberation Time of Studios.—W. Reichardt, E. Kohlsdorf & H. Mutscher. (*Hochfrequenztech. u. Elektroakust.*, July 1955, Vol. 64, No. 1, pp. 18–25.) The reported tests, involving 85 listeners, lead to results similar to those obtained by Kuhl (620 of 1955). While the mean reverberation characteristic adjudged optimum agreed with the accepted characteristic, the preferred reverberation times varied with the type of music.

534.846 **11**

Comparison of Objective and Subjective Observations on Music Rooms.—J. Blankenship, R. B. Fitzgerald & R. N. Lane. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 774–780.) Experiments made at the University of Texas are reported; an attempt is made to relate the terminology and viewpoints of architects, physicists and musicians.

621.395.623.7 **12**

The Twin-Cone Moving-Coil Loudspeaker.—J. J. Schurink. (*Philips tech. Rev.*, March 1955, Vol. 16, No. 9, pp. 241–249.) A description is given of a loudspeaker with a small cone arranged inside and attached to a larger cone; satisfactory response is obtained at frequencies up to about 18 kc/s. Advantages of this arrangement over the use of separate loudspeakers for the upper and lower a.f. ranges are indicated.

621.395.625 : 621.317.76 **13**

Measurement of "Wow" and "Flutter".—O. E. Dzierzynski. (*Wireless World*, Nov. 1955, Vol. 61, No. 11, pp. 547–552.) The subject is discussed generally and a detailed description of a flutter meter is given.

AERIALS AND TRANSMISSION LINES

621.315.2 : 621.396.97 **14**

Transmission Properties of Low-Frequency Programme Lines used in German Carrier-Frequency Trunk Cables.—E. A. Pavel. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 455–461.) Report of tests on a 2 212-km a.f. line superimposed on carrier-frequency cable. Lines of this type more than satisfy C.C.I.R. transmission-quality requirements for distances up to at least 4 000 km. See also 1578 of 1953 (Pavel & v. Schau).

621.315.212 (083.74) **15**

Present Position on Standardization of High-Frequency Coaxial Transmission Cables.—H. Peters. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 443–444.) Reasons are given for the retention in Germany of 60 Ω as the standard values of characteristic impedance for h.f. coaxial cables, in spite of international standardization on 50 Ω and 75 Ω. See also 2299 of 1954 (Gutzmann).

621.372.2 **16**

Propagation of Microwaves on a Single Wire: Part I.—S. K. Chatterjee & P. Madhavan. (*J. Indian Inst. Sci.*, Section B, July 1955, Vol. 37, No. 3, pp. 200–223.) "Some quantitative measurements on cylindrical surface waves excited on a cylindrical bare copper conductor have been made at 3·2-cm wavelength. The results on radial field measurements indicate fair agreement with results predicted by theory. The decay coefficient for the radial field is 14·0 m^{-1}. It is suggested that the surface conductivity of metals in the form of wire can be found at microwave frequencies by using this method. Field distributions near the launching horn have been found to be considerably distorted due probably to the presence of complementary waves. The design and constructional details of the launching system, probe, etc. used in the experiment are presented."

621.372.8 + 621.372.413 **17**

A Step-by-Step Method for designing Waveguides and Oscillatory Systems.—M. S. Neyman. (*Radiotekhnika, Moscow*, Jan. 1955, Vol. 10, No. 1, pp. 12–22.) A method is proposed which permits calculation of the parameters of distributed electromagnetic systems such as waveguides and cavity resonators without recourse to electrodynamic wave equations. Rectangular and cylindrical waveguides and resonators are considered as examples.

621.372.8 **18**

Calculation of the Angular Momentum of the Electromagnetic Field in a Waveguide.—L. Ronchi & G. Toraldo di Francia. (*Alta Frequenza*, June 1955, Vol. 24, No. 3, pp. 204–218.) General formulae for the flux of the angular momentum of the e.m. field are applied to the case of a circular waveguide in which only the TE_{11} mode is propagated; an investigation is made of the types of polarization possible. For the case of a guide containing a polarization converter calculations are made of the angular momentum delivered to the converter per unit of time when the polarization is converted from elliptical to linear; two different methods are used.

621.372.8 **19**

Theory of Circularly Symmetric Standing TM Waves in Terminated Iris-Loaded Guides.—C. C. Grosjean. (*Nuovo Cim.*, 1st July 1955, Vol. 2, No. 1, pp. 11–26. In English.) An exact treatment is developed based on matching the field components at the diaphragm apertures, and on similar lines to that described previously (2832 of 1955) in relation to infinite guides.

621.372.8 : 538.22 **20**

Electromagnetic Waves in a Magnetized Ferrite in the Presence of Conducting Planes.—A. L. Mikaelyan & A. A. Pistol'kors. (*Radiotekhnika, Moscow*, March 1955, Vol. 10, No. 3, pp. 14–24.) Theory is presented for the propagation of electromagnetic waves in an infinite space between ideally conducting planes, the space being totally or partially filled with ferrite and a constant magnetic field oriented in various directions being applied.

621.372.8 : 621.315.6 **21**

Propagation Coefficients of Waves on Dielectric Tubes.—H. G. Unger. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 438–443.) See 3458 of 1954.

621.372.8 : 621.396.11.029.4/.51 : 551.510.535 **22**

The Radial Propagation of Electromagnetic Waves between Two [parallel] **Conducting Planes (Radial Waveguide).**—H. Kaden. (*Frequenz*, July 1955, Vol. 9, No. 7, pp. 241–249.) In the radial waveguide E and H modes propagate as in a linear guide, the orientation of the modes being with respect to the normal to the conducting planes. The theory is used to calculate the 'internal' and 'external' dynamic capacitance of a parallel-plate capacitor. The radiation from electric and magnetic dipoles situated between the planes is also calculated; the result represents to a close approximation the conditions for propagation of long waves ($\lambda > 3$ km) in the guide formed between the earth and the ionosphere. The number of modes propagated varies inversely as λ and the field-strength/distance curve at the earth's surface is of the nature of a statistical function, since many incommensurable waves interfere mutually. Resonance effects occur when the height of the ionosphere is an integral multiple of $\lambda/2$, both the distant field strength and the retroaction of the radiation on the dipole becoming very great.

621.396.677 : 523.16 **23**

Chord Construction for Correcting Aerial Smoothing.—Bracewell. (See 98.)

AUTOMATIC COMPUTERS

681.142 **24**

The Design and Construction of a High-Speed Electronic Differential Analyzer.—N. N. Biswas, V. N. Chiplunkar & V. C. Rideout. (*J. Indian Inst. Sci.*, Section B, July 1955, Vol. 37, No. 3, pp. 186–199.)

681.142 **25**

Improvement of an Iteration Process suitable for Automatic Division.—C. Böhm. (*Ricerca sci.*, July 1955, Vol. 25, No. 7, pp. 2077–2080.) Electronic computers having no organ of division are provided with a subroutine for the computation of reciprocals. An improvement of this subroutine is proposed which permits a reduction of about 30% in the number of operations without affecting the accuracy.

681.142 : 413 **26**

Use of a Computing Machine as a Mechanical Dictionary.—A. D. Booth. (*Nature, Lond.*, 17th Sept. 1955, Vol. 176, No. 4481, p. 565.) The time required to locate a stored word is reduced by applying binary-division principles in the searching process.

681.142 : 621.3.078/.079 **27**

Industrial Uses of Special-Purpose Computers.—A. H. Kuhnel. (*Instrum. & Automation*, July 1955, Vol. 28, No. 7, Part 1, pp. 1108–1113.) An account is presented of the analysis of a simple machine-control problem and the design of a suitable special-purpose computer to perform the task. Economic factors are also briefly considered.

681.142 : 621.318.5 **28**

A Method for Synthesizing Sequential Circuits.—G. H. Mealy. (*Bell Syst. tech. J.*, Sept. 1955, Vol. 34, No. 5, pp. 1045–1079.) A theory is developed from design procedures suggested by Huffman (*J. Franklin Inst.*, March & April 1954, Vol. 257, pp. 161–190 & 275–303) and Moore (to be published in Automata Studies, Princeton Univ. Press) enabling intricate relay systems to be built up from an initial diagrammatic statement of the essential requirements. By successive application of simplifying reductions a unique circuit is finally obtained.

681.142 : 621.372.45 **29**

A Nonlinear Resistance-Capacitance Circuit.—F. A. Key & W. G. P. Lamb. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 446–448.) An amplifier in a negative-feedback loop is used to provide the nonlinear resistance in an analogue equipment representing air-pressure variations.

681.142 : 621.383 **30**

A Photoelectric Analogue Computer for investigating the Dynamic Behaviour of Linear Systems.—S. Kitsopoulos. (*Bull. schweiz. elektrotech. Ver.*, 23rd July 1955, Vol. 46, No. 15, pp. 690–693.) Apparatus is described for determining the output function of a linear system such as an amplifier or servomechanism when the input and transfer functions are known. The two known functions are represented by appropriately shaped apertures in diaphragms interposed between light source and photocell; the mechanical system used to produce the required continuous variation of the input function is described in detail.

681.142 : 621.395.625.3 **31**

High-Density Tape Recording for Digital Computers.—(*Tech. News Bull. nat. Bur. Stand.*, Sept. 1955, Vol. 39, No. 9, pp. 121–124.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3 (083.7) **32**

Standardization of Electronic Components.—H. W. Ghijsen. (*Tijdschr. ned. Radiogenoot.*, July 1955, Vol. 20, No. 4, pp. 227–242. In English.) A survey with particular reference to the activities of the International Electrotechnical Commission.

621.316.8 + 621.318.42 + 621.319.4].011.2 **33**

The Impedance of Chokes, Resistors and Capacitors at High Frequency.—A. Weis. (*Frequenz*, July 1955, Vol. 9, No. 7, pp. 221–227.) Analysis indicates that in order to represent the impedance variation of cylindrical inductors, resistors and capacitors at frequencies above the first resonance point, equivalent circuits are needed combining a ladder network with simple parallel or series networks; nonuniform field distribution along the component can then be taken into account. The validity of the theory is confirmed by reference to measurement results, shown graphically. The effect of an earthing lead on a lead-through capacitor is demonstrated.

621.316.86 : 621.396.822 **34**

Contact Noise.—B. S. Gal'perin. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 410–413.) A composition resistor is considered as consisting of a number of parallel circuits each containing an equal number of particles and the same number of contacts of equal resistance. It is shown that the noise energy of such a homogeneous system is equal to that of a single contact and that for a given gradient of the applied direct voltage it is determined by the degree of dispersion and the specific resistance of the conductor material. Expressions are also derived for heterogeneous systems and imperfect contacts.

621.316.86.049.75 **35**

Printed Resistors.—R. S. Marty, E. M. Davies & P. J. Franklin. (*Elect. Mfg*, Jan. 1955, Vol. 55, No. 1, pp. 56–63.) Preparation of resistors by injection moulding is described. The effect of ink composition and the printing and curing processes on the resistor characteristics are described.

621.318.435 : 621.373.43 **36**

Magnetic Pulse Modulators.—K. J. Busch, A. D. Hasley & C. Neitzert. (*Bell Syst. tech. J.*, Sept. 1955, Vol. 34, No. 5, pp. 943–993.) Mathematical analyses are given of a.c.- and d.c.-charged series-type saturable reactors for generating pulses in radar systems. Automatic core resetting is achieved. The production of pulses of duration $< 0{\cdot}1\ \mu s$ and the prevention of parasitics in the output are discussed and a circuit is described enabling the thyratron cathode in a d.c.-charged modulator to be operated at ground potential.

621.318.57 : 621.374.32 : 621.314.7 **37**

A Multistable Transistor Circuit.—R. A. Henle. (*Elect. Engng, N.Y.*, July 1955, Vol. 74, No. 7, pp. 570–572.)

621.372.4 **38**

Proof of a Theorem on the Equivalence of Two-Pole Networks with only Two Types of Impedance Element.—S. Spiess. (*Hochfrequenztech. u. Elektroakust.*, July 1955, Vol. 64, No. 1, pp. 25–32.) Note on 961 of 1955 (Weber & Schlegel).

621.372.41 **39**

Theorem on the Reactive Energy in an Electric Dipole in a State of Variation.—L. Lunelli. (*Alta Frequenza*, June 1955, Vol. 24, No. 3, pp. 246–267.) Analysis is based on differentiation of the operational impedance. A simple formula is derived giving the instantaneous difference between the stored magnetic and electric energy.

621.372.413 + 621.372.8 **40**

A Step-by-Step Method for designing Waveguides and Oscillatory Systems.—Neyman. (See 17.)

621.372.5 **41**

Some Fundamental Properties of Networks without Mutual Inductance.—A. Talbot. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 168–175. Digest, *ibid.*, Part B, July 1955, Vol. 102, No. 4, pp. 554–555.) Elementary methods not involving determinants are used to prove theorems on the voltage and current gains obtainable from a resistance network. The results are used to determine properties of general networks without mutual inductance; *RC* networks are investigated by a method simpler than that of Fialkow & Gerst (3369 of 1952). Attention is drawn to a neglected paper by Kirchhoff (*Ann. Phys. Chem.*, 1847, Vol. 72, p. 497) giving the foundations of the topology of networks.

621.372.5 **42**

Synthesis of Ladder Networks to give Butterworth or Chebyshev Response in the Pass Band.—E. Green. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, p. 290.) Addendum to 370 of 1955.

621.372.5 **43**

Ladder Networks with Similar Quadripole Sections.—U. Ruelle. (*Alta Frequenza*, June 1955, Vol. 24, No. 3, pp. 268–283.) Formulae for the section input and output currents and voltages and input impedances are derived directly from Kirchhoff's laws, using determinants.

621.372.5 : 512.83 **44**

On Node and Mesh Determinants.—S. Okada. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, p. 1527.) An extension of the analysis presented by Seshu (1581 of 1955).

621.372.512.3.015.3 **45**

Initial Transients in some Special Passive Networks with Amplitude and Frequency Modulation.—E. Henze. (*Arch. elekt. Übertragung*, July 1955, Vol. 9, No. 7, pp. 326–338.) It is shown that for multistage selective circuits there is an optimum coupling for which the output corresponding to unit-step input is aperiodic and free from overshoot. The performance of two frequency-shift circuits is studied, and the existence of an optimum ratio of shift to keying frequency is demonstrated. A formula is derived for calculating distortion factor for two-circuit band-pass filters with f.m.

621.372.54 **46**

New Filter Theory of Periodic Structures.—W. K. R. Lippert. (*Wireless Engr*, Oct. & Nov. 1955, Vol. 32, Nos. 10 & 11, pp. 260–266 & 305–310.) Theory for linear passive quadripoles is developed in terms of characteristic reflection and transmission factors which can be specified by reference to the standing-wave pattern on lines connected to the input and output. The relations between these factors and the usual circuit constants, particularly the image function of symmetrical circuits, are studied. The method is illustrated by examining multisection structures combining quadripoles and loss-free lines. The use of these characteristic factors leads to major simplifications in dealing with loss-free structures, where most of the work can be done graphically.

621.372.542.2 : 621.396.61 **47**

A Ten-Kilowatt Low-Pass Filter.—E. R. Broad & E. J. P. May. (*P.O. elect. Engrs' J.*, July 1955, Vol. 48, Part 2, pp. 94–96.) The filter is designed for use in the aerial feed lines of transmitters working in the frequency range 4–28 Mc/s and discriminates by about 60 dB against any frequencies in the television band 40–70 Mc/s which may be present as harmonics. In measuring the effectiveness of the filter account must be taken of radiation from sources other than the aerial.

621.372.542.32 : 621.372.412 **48**

A Piezoelectric High-Pass Filter.—Ya. I. Velikin, Z. Ya. Gel'mont & E. V. Zelyakh. (*Radiotekhnika, Moscow*, March 1955, Vol. 10, No. 3, pp. 41–49.) A lattice filter is considered (Fig. 1) whose special feature is the use of transformers in its arms, with crystals included in the secondary circuits. The main parameters of the filter are determined, and formulae are derived for calculating the resonance and antiresonance frequencies of the arms. A method is proposed for designing the filter elements and for calculating its basic loss. The experimental curve of a filter designed in this manner (Fig. 7) shows a sharp cut-off.

621.372.543.2.029.4 **49**

A High-*Q RC* Feedback Filter.—M. J. Tucker & L. Draper. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 451–453.) Description of the design and construction of a 175-c/s acceptor filter which will maintain a Q of 1 000 stable to within 2% over one hour and a Q of 500 to within 2% over considerable periods. The circuit uses a twin-T rejector filter in the negative-feedback path of an amplifier.

621.372.56 : 621.314.632 **50**

A Voltage-Controlled Attenuator.—G. M. Ettinger. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 458–459.) "A three-stage voltage controlled germanium diode attenuator is described. Transmission may be varied over a range exceeding 35 decibels by a 12 V control signal. Push-pull operation is discussed and various applications are suggested."

621.372.56.029.6 : 621.372.8 **51**

An S-Band Variable Attenuator For High-Power Working.—B. E. Kingdon. (*J. Brit. Instn Radio Engrs*, Sept. 1955, Vol. 15, No. 9, pp. 471–478.) "The description is given of a waveguide insertion attenuator in which the loss in r.f. power is produced by the action of a column of water flowing in a glass tube mounted in the waveguide, continuous variation of attenuation being obtained by adjustment of the water column height. Resonance effects in the water column are exploited by choosing the cross-sectional dimensions of the glass such that an optimum attenuation per unit length of tube is obtained. Experimental results are given for a model covering the range 0 to 30 dB, the input v.s.w.r. at $\lambda_0 = 10{\cdot}00$ cm being $< 0{\cdot}87$ at any setting and $> 0{\cdot}97$ over the greater part of the range. Satisfactory operation has been achieved in an evacuated test-system fed by a magnetron delivering 2 MW peak power (200 W mean) at a wavelength of 10 cm. Various modifications in design are suggested for use with higher mean powers."

621.372.6 **52**

The Graphs of Active Networks.—W. S. Percival. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 270–278. Digest, *ibid.*, Part B, Sept. 1955, Vol. 102, No. 5, pp. 727–729.) Results obtained previously (2587 of 1953 and 379 of 1955) are used to develop the properties of the graphs of linear networks including valves and transformers.

621.373.4 + 621.376.32 **53**

Linear and Nonlinear Effects in Reactance and Oscillator Circuits.—T. Zagajewski. (*Hochfrequenztech. u. Electroakust.*, July 1955, Vol. 64, No. 1, pp. 8–18.) The analysis presented of the behaviour of a reactance

valve in various circuits is based on an expression for the anode current containing terms up to the third degree in the grid and anode voltages. Two nonlinear effects are considered: (*a*) the primary effect of the curvature in the valve characteristic, and (*b*) the secondary effect due to the presence of harmonic components in the applied signal. These were also investigated experimentally and the results are presented graphically. A circuit for reducing the effect of nonlinearity was also investigated.

621.373.4 **54**

Stability of Oscillation in Valve Generators.—A. S. Gladwin. (*Wireless Engr*, Aug.–Nov. 1955, Vol. 32, Nos. 8–11, pp. 206–214, 246–253, 272–279 & 297–304.) "A comprehensive theory of stability is developed which is applicable to a large class of harmonic oscillators. The paper is concerned mainly with the 4-terminal regenerative type of oscillator with grid-leak bias but the analysis applies also to circuits with fixed grid-bias and to 2-terminal oscillators. All known forms of instability appear as special cases of the general theory and some new forms are predicted. Stability is determined by the nature of the roots of a characteristic equation and stability criteria are obtained in the form of inequalities between the parameters of the amplifier and feedback network. A modified form of Nyquist locus-diagram can also be used. When the feedback network is symmetrical with respect to the oscillation frequency the characteristic equation can be factorized to give independent criteria for frequency and amplitude stability. Hysteresis effects and periodic instability are analysed in detail. In addition to the general treatment, specific forms of the various parameters which appear in the stability criteria are worked out for a three-halves-law amplifier with a semi-linear or exponential grid-current characteristic. Quantitative experimental confirmation is provided."

621.373.4 : 621.396.822 **55**

Effect of Electrical Fluctuations on a Valve Oscillator.—P. I. Kuznetsov, R. L. Stratonovich & V. I. Tikhonov. (*Zh. eksp. teor. Fiz.*, May 1955, Vol. 28, No. 5, pp. 509–523.) The effect of 'slow' normal fluctuations is considered. Expressions are derived for the one-dimensional probability density functions for amplitude and phase. An approximate method is shown for calculating the correlation functions for amplitude and phase variations.

621.373.421 : 621-526 **56**

The Frequency-Response Analysis of Nonlinear Systems.—P. E. W. Grensted. (*Proc. Instn elect. Engrs*, Part C, September 1955, Vol. 102, No. 2, pp. 244–253. Digest, *ibid.*, Part B, Sept. 1955, Vol. 102, No. 5, pp. 721–723.) If the waveform at the input to the nonlinear elements in the system is approximately sinusoidal, the analysis may be carried out on the assumption that all harmonics generated by the nonlinear elements can be ignored. Analysis of on-off control systems on this basis gives results within about 10% of the exact solutions for both transient and steady oscillations.

621.373.421.13 **57**

Synthesizing Crystal Stability.—W. A. Hayes. (*Radio-Electronic Engng*, May 1955, Vol. 24, No. 5, pp. 20, 30.) The output from two crystal oscillators, combined to give a 10-kc/s beat frequency, is squared and triggers a blocking oscillator, producing a 10-kc/s pulse which is used to quench a tunable oscillator. The tunable oscillator locks to harmonics of the 10-kc/s signal.

621.373.423 : 621.316.726 **58**

An Electromechanical Stabilizer of the Frequency of a Klystron.—A. I. Barchukov, G. A. Vasil'ev, M. E. Zhabotinski & B. D. Osipov. (*Radiotekhnika, Moscow*, March 1955, Vol. 10, No. 3, pp. 29–32.) In the method proposed a portion of the klystron output is applied to a cavity resonator, the natural frequency of which is modulated by a separately excited vibrating diaphragm. The output of the resonator is detected, amplified and, through a phase detector, applied to the klystron reflector. The theory of the method is discussed and its accuracy is determined. A comparison with the resonance frequency of the absorption line of ammonia has shown that the relative frequency error of the method is of the order of 5×10^{-8}.

621.373.424.029.42 **59**

Subaudio Oscillator Tunes 0 to 50 cycles.—L. Fleming & W. W. Follin. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 144–145.) A beat-frequency oscillator using carrier frequencies of about 2 kc/s provides an output of up to 3 V constant within 2% over the frequency range, with $< 0{\cdot}2$ c/s per hour drift and $< 1\%$ distortion. The need for low-frequency amplification is avoided by the use of a high-level mixer circuit consisting of two Se rectifiers with balancing adjustment to eliminate the d.c. component.

621.374.3 : 621.315.212 **60**

Some Transmission Line Devices for Use with Millimicrosecond Pulses.—I. A. D. Lewis. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 448–450.) A phase inverter, impedance transformers and a valve-heater isolating transformer are described, all comprising coaxial-cable sections.

621.374.4 : 621.385.832 **61**

Generation of Harmonics of a Given Fundamental.—H. Katz & K. L. Rau. (*Frequenz*, July 1955, Vol. 9, No. 7, pp. 234–240.) Theory and experimental results are given for a frequency multiplier based on use of a c.r. tube in which a ribbon beam is deflected across a metal target with an appropriate profile. Suitable beam-forming structures are described.

621.375.1.029.63 : 621.396.822 **62**

Noise in U.H.F. Amplifiers.—E. P. Dement'ev. (*Radiotekhnika, Moscow*, Jan. 1955, Vol. 10, No. 1, pp. 45–52.) General noise effects in u.h.f. amplifiers of any type are considered. Relations between the noise parameters are established using the method of the transfer of the current generators proposed previously (*ibid.*, 1954, No. 4.) General expressions for the noise factors are derived, and the minimum number of noise parameters required to characterize a circuit is determined. A concept of 'partial' noise parameters is introduced.

621.375.232 : 623.011.21 **63**

A Negative Impedance Converter for Use as a Two-Terminal Amplifier.—J. R. Tillman. (*P.O. elect. Engrs' J.*, July 1955, Vol. 48, Part 2, pp. 97–101.) A specified stable negative impedance may be generated by connecting a positive impedance between the output and input of an amplifier possessing a high degree of negative feedback. An amplifier suitable for use in transmission-line systems is described.

621.375.3.049.75 **64**

Etched Wiring simplifies Magnetic Amplifier Design.—K. H. Sueker. (*Elect. Mfg*, Jan. 1955, Vol. 55, No. 1, pp. 106–107.)

621.373/.376 **65**

Active Networks. [Book Review]—V. C. Rideout. Publishers: Prentice-Hall, New York, and Constable, London, 1954, 485 pp., 42s. (*Sci. Progr.*, July 1955, Vol. 43, No. 171, pp. 534–535.) Deals with circuits including valves, transistors and other devices. There are sections on the basic principles of analogue computers, servo systems and wave-shaping circuits as well as on general aspects of amplifiers and oscillators.

GENERAL PHYSICS

53.087/.088 **66**

The Correction of Observational Data for Instrumental Bandwidth.—F. D. Kahn. (*Proc. Camb. phil. Soc.*, July 1955, Vol. 51, Part 3, pp. 519–525.) The formula relating the readings, $\phi(x)$, of an instrument having the apparatus function $g(x)$ to the true values $f(x)$ of an observed function is stated. A three-point interpolation operator can be chosen to simulate the spreading action of a class of functions $g(x)$. Under certain conditions the interpolation operator has an exact inverse which, when applied to $\phi(x)$, gives a function which is a better approximation to $f(x)$. The accuracy obtained is discussed, and the effect of the method on the standard errors in the measurement is found.

531 + 537].001.362 **67**

Electromechanical Analogies.—G. Meyer. (*Frequenz*, July 1955, Vol. 9, No. 7, pp. 227–232.) A discussion of the physical significance of various analogies and of circuit concepts and terminal representation in mechanics.

535.215 **68**

State of Research on Photoelectricity.—W. Kluge. (*Z. angew. Phys.*, June 1955, Vol. 7, No. 6, pp. 302–311.) A survey is presented of research since 1949. 122 references.

535.22 **69**

Velocity of Light from the Molecular Constants of Carbon Monoxide.—E. K. Plyler, L. R. Blaine & W. S. Connor. (*J. opt. Soc. Amer.*, Feb. 1955, Vol. 45, No. 2, pp. 102–106.) From infrared spectroscopy measurements the value of 299 792 km/s is deduced for the velocity of light, with a standard deviation of 6 km/s. A short account of the work is given in *Tech. News Bull. nat. Bur. Stand.*, Jan. 1955, Vol. 39, No. 1, pp. 1–3.

535.642.08 **70**

Simple Color Computer Gives Tristimulus Values.—R. P. Burr & J. R. White. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 166–169.) Trichromatic coefficients for the CIE colour-specification system are automatically computed on a simple analogue machine.

537.223/.224 **71**

An Interesting Phenomenon Observed on some Dielectrics.—I. Sumoto. (*J. phys. Soc. Japan*, June 1955, Vol. 10, No. 6, p. 494.) A glass tube, either empty or containing a polar liquid or a metal rod, rotates continuously when placed in an inhomogeneous electric field of sufficient strength if the electrodes and part of the tube are immersed in carnauba wax or a higher alcohol, stearic acid, palmitic acid or xylol.

537.29 : 621.315.61 **72**

Field-Dependent Conductivity in Nonuniform Fields and its Relation to Electrical Breakdown.—P. T. G. Flynn. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 264–269. Digest, *ibid.*, Part B, Vol. 102, No. 5, pp. 723–725.) "A method is given for calculating the resulting field distribution when the conductivity is a function of the field strength. This is applied to a point-plane electrode system in an amorphous solid, with the assumption that the conductivity at low field-strengths is electronic and that the conductivity at high field-strengths is described by a relation due to Fröhlich. The results show that for polymethylmethacrylate with average fields of the order of 10^6 volt/cm, the reduction in maximum field-strength from that calculated for constant conductivity can be a factor of five or more, the magnitude of the reduction depending on the degree of non-uniformity of the field." Various other insulating materials are also discussed.

537.5 : 538.561 **73**

Study of Gyromagnetic Resonance in the Penning Gauge.—G. Dumas. (*Rev. gén. Elect.*, July 1955, Vol. 64, No. 7, pp. 331–350.) Conditions in the Penning gauge are particularly favourable for studying r.f. radiation resulting from gyromagnetic resonance of electrons [see 1139 of 1951 (Laffineur & Pecker)]. Both longitudinal oscillations and thermal agitation of the electrons are involved, resulting in an accumulation in the anode plane. The presence of plasma has an important effect on the potential distribution, introducing a radial electric field. The equations of electron motion are established; some particular solutions indicate the possibility of a circular path in the anode plane, with an angular frequency about half the gyrofrequency. With values of magnetic induction between 100 and 1 000 G radiation at decimetre wavelengths was produced. Measurements of the radiation are described. Investigation of the complete spectrum emitted indicates that coherent oscillations may occur. The results are compared with those of other workers.

537.52 : 535.215.9 **74**

Influence of Light on the Mechanism of Gas Discharges (Joshi Effect).—S. R. Mohanty. (*Z. Phys.*, 20th April 1955, Vol. 140, No. 4, pp. 370–375.) Results of previous experimental work are reviewed. The variation of the discharge current with the intensity and frequency of the incident light and in particular the reversal of this current variation in a certain voltage range are interpreted in terms of space-charge effects.

537.533 **75**

The Mechanism of High-Field Electron Emission from Tarnished Metal Surfaces.—T. J. Lewis. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 504–512.) A theory of field-dependent thermal emission is proposed which takes into account the existence of patch fields due to variation in work function over the surface.

537.533 **76**

Numerical Ray Tracing in Electron Lenses.—J. C. E. Jennings & R. G. Pratt. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 526–536.) Corrections are suggested to Liebmann's formulae for tracing paraxial rays (966 of 1950); a more accurate method is developed, applicable also to marginal rays, and is compared with methods suggested by other workers. The use of the constancy of the Wronskian determinant as a criterion of accuracy of paraxial ray tracing is discussed.

537.533 **77**

Effect of Space Charge on the Propagation of Intense Beams of Charged Particles.—M. D. Gabovich. (*Uspekhi fiz. Nauk*, June 1955, Vol. 56, No. 2, pp. 215–256.) A review. About a third of the 81 references given are to Russian work.

537.533 : 538.691 **78**

A Method of finding a Large Class of Electrostatic and Magnetic Fields for which the Solutions of the Fundamental Equation of Electron Optics may be expressed in Terms of Known Functions.—B. E. Bonshtedt. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 541–543.) Exact solutions of equation (1) are of great interest for various types of e.s. and magnetic fields. Until recently such solutions were known only for a very limited number of cases. Grinberg in particular indicated a class of fields for which the trajectories of electrons are expressed in terms of cylindrical functions (*Zh. tekh. Fiz.*, 1953, Vol. 23, p. 1904). Solutions are now found for a much larger class of fields.

537.533.1 **79**

Velocity Distribution of Electrons in Presence of an Alternating Electric Field and Constant Magnetic Field.—V. M. Fain. (*Zh. eksp. teor. Fiz.*, April 1955, Vol. 28, No. 4, pp. 422–430.) Two cases are considered theoretically: (*a*) the electric field varies sinusoidally, and (*b*) the variation is amplitude modulated. Case (*b*) is of interest in the investigation of ionospheric cross-modulation. The effect of collisions between electrons is taken into account.

537.562 : 621.317.335.3 : 621.372.413 **80**

Resonant-Cavity Measurements of the Relative Permittivity of a D.C. Discharge.—K. W. H. Foulds. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 203–216. Digest, *ibid.*, Part B, July 1955, Vol. 102, No. 4, pp. 564–567.) Measurements at 2·1, 2·5 and 3 kMc/s on low-pressure d.c. discharges in (*a*) a mixture of Hg vapour and Ar, and (*b*) Hg vapour alone. Decrease of permittivity with increase of discharge current was noted in all cases. In case (*b*) the cavity *Q*-factor exhibited a minimum at a value of discharge current depending on the resonance frequency; this is attributed to electron resonance. Theory of the method is given.

538.1 **81**

General Theory of Magnetic Masses at Rest and in Movement.—É. Durand. (*Rev. gén. Élect.*, July 1955, Vol. 64, No. 7, pp. 350–356.) Theory is presented based on the analogy with electric charge.

538.1 **82**

A New Vectorial Transformation of a Curved-Line Integral into a Surface Integral, and its Application to Magnetostatics.—É. Durand. (*C. R. Acad. Sci., Paris*, 17th Aug. 1955, Vol. 241, No. 7, pp. 594–596.)

538.1 : 538.221 **83**

Magnetostatics with Ferromagnetic Materials.—V. I. Skobelkin & R. N. Solomko. (*Zh. eksp. teor. Fiz.*, April 1955, Vol. 28, No. 4, pp. 385–393. Correction, *ibid.*, June 1955, No. 6, p. 766.) A variational principle is formulated and proved in the theory of ferromagnetic materials in the field of electric currents. A direct method is developed for investigating magnetic fields in the general case of a nonlinear dependence of permeability on magnetic field strength.

538.3 **84**

Comments on the Nonlinear Electrodynamics.—K. Bechert. (*Ann. Phys., Lpz.*, 15th July 1955, Vol. 16, Nos. 3/4, pp. 97–110.) Some solutions of the equations presented earlier (1969 of 1953) are examined.

538.3 : 512.831 **85**

Description of the Electromagnetic Field by means of Matrices.—G. A. Zaitsev. (*Zh. eksp. teor. Fiz.*, May 1955, Vol. 28, No. 5, pp. 524–529.) The properties of 'matrix-tensors' are briefly considered and the quantities characterizing an e.m. field are then expressed in matrix form.

538.56 : 537.5 **86**

Note on Plasma-Electron Oscillations.—K. G. Emeleus & T. K. Allen. (*Aust. J. Phys.*, June 1955, Vol. 8, No. 2, pp. 305–306.) Brief report of the results of experiments on hot-cathode discharges in Hg vapour or Ar at pressures of the order of 10^{-3} mm Hg, and discussion of their relation to the work of Wild et al. (704 of 1955).

538.566 **87**

The Perturbation of an Electromagnetic Field by Small Deformations of a Metal Surface.—B. Z. Katsenelenbaum. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 546–557.) A general expression is derived for the perturbation due to the deformation. If the deformation is slight this perturbation can be found by the usual method of quadratures. The method is applied to the problem of the diffraction of a plane wave at a step, the height of which is small compared with λ. From this the well-known formulae of Rayleigh for reflection from small and smooth irregularities are easily derived.

538.566 **88**

Study of the Local Electromagnetic Field at the Junction of Three Dielectric Media.—G. Weill. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 554–556.) Analysis is given for the case of three media with a common edge.

538.566 : 535.42 **89**

A Diffraction Problem.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 22nd Aug. 1955, Vol. 241, No. 8, pp. 625–627.) Analysis is presented for the case of a plane e.m. wave incident normally on an infinitely long perfectly conducting strip.

538.566 : 537.31 **90**

Scattering of Electromagnetic Waves from a 'Lossy' Strip on a Conducting Plane.—J. R. Wait. (*Canad. J. Phys.*, July 1955, Vol. 33, No. 7, pp. 383–390.) An examination is made of the error introduced in the analysis of radiation and propagation problems by assuming perfect conductivity in media, such as the ground, which are in fact imperfectly conducting. The result of the approximate calculation is compared with that of an exact calculation involving elliptic wave functions. For the approximation to be permissible, the surface impedance of the lossy regions should not exceed 0·1 times the impedance of free space.

538.566 : 537.56 **91**

Hydromagnetic Waves in Ionized Gas.—J. H. Piddington. (*Nature, Lond.*, 10th Sept. 1955, Vol. 176, No. 4480, p. 508.) The equation representing the e.m. field in a moving isotropically conducting medium is discussed and expressions are derived for the velocities of the ordinary, extraordinary and *S* (sound-type) waves, for gas pressures (*a*) much less than and (*b*) much greater than the 'magnetic pressure'. See also 3579 of 1955.

538.569.4 : 535.33 **92**

New Technique for High-Resolution Microwave Spectroscopy.—R. H. Romer & R. H. Dicke. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 532–536.) Spectral lines of width substantially less than the Doppler width are produced by containing the gas in a pillbox-shaped cavity of height about $\lambda/2$ and diameter large compared to λ.

538.615 : 538.569.4.029.6 : 546.171.1 **93**

The Zeeman Effect in Ammonia Microwave Spectra.—Y. Torizuka, Y. Kojima, T. Okamura & K. Kamiryo. (*J. phys. Soc. Japan*, June 1955, Vol. 10, No. 6, pp. 417–420; *Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, June 1955, Vol. 7, No. 3, pp. 316–320.) The Zeeman effect was investigated experimentally using magnetic fields up to 15 000 oersted. Results indicate that the $J = 1, K = 1$ line shows a change from the Zeeman effect to the Paschen-Back effect at field strengths near 10 000 oersted.

538.63 : 538.221 **94**

Theory of the Nernst Effect in Ferromagnetic Metals.—K. Meyer. (*Z. Naturf.*, Feb. 1955, Vol. 10a, No. 2, p. 166.) On the basis of a two-band model with one band nearly empty and the other nearly fully occupied, theory for the Nernst effect can be derived simply from that for the Hall effect.

538.632 **95**

The Hall Effect and Related Phenomena.—F. A. Vick. (*Sci. Progr.*, July 1955, Vol. 43, No. 171, pp. 454–461.) A brief review is presented of recent work on the theory of the Hall effect in ferromagnetic, in strongly paramagnetic, and in semiconducting materials. Practical applications of the effect, such as in the InSb power amplifier [2576 of September (Ross & Thompson)] are also mentioned.

539.155 **96**

Reliability of Atomic Masses in the Chromium-Germanium Region.—J. T. Kerr, J. G. V. Taylor & H. E. Duckworth. (*Nature Lond.*, 3rd Sept. 1955, Vol. 176, No. 4479, pp. 458–459.) Discrepancies between atomic-mass values obtained from transmission data and those obtained by mass-spectrometer methods are discussed. The mass-spectrometer values for Ni may be in error, but those for the other elements from Cr to Ge are considered to be accurate.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 : 523.3 **97**

Lunar Occultation of a Radio Star and the Derivation of an Upper Limit for the Density of the Lunar Atmosphere.—B. Elsmore & G. R. Whitfield. (*Nature, Lond.*, 3rd Sept. 1955, Vol. 176, No. 4479, pp. 457–458.) Brief report of observations made at Cambridge, England, of the passage of the moon across the large-diameter radio source in Gemini. Wavelengths of 7·9 and 3·7 m were used.

523.16 : 621.396.677 **98**

Chord Construction for Correcting Aerial Smoothing.—R. N. Bracewell. (*Aust. J. Phys.*, June 1955, Vol. 8, No. 2, pp. 200–205.) A graphical method of correcting for aerial smoothing in radio astronomy, simpler and no less accurate than methods described previously.

523.5 : 621.396.96 **99**

The Influence of Noise on Radar Meteor Observations.—C. D. Ellyett & G. J. Fraser. (*Aust. J. Phys.*, June 1955, Vol. 8, No. 2, pp. 273–278.) An experimental investigation has been made of the minimum detectable echo power from meteor trails using 69-Mc/s radar equipment with incoherent detection. For optimum signal/noise ratio the pulse width must exceed the width of the c.r.-tube spot. Extraterrestrial noise is predominant, receiver noise figure being of second-order importance. Variations in the effective aerial temperature introduce corresponding variations in the observed meteor rate. Using artificial echoes, a minimum signal/noise ratio of 8 dB is found to be necessary for detection; the most important parameter is the total received signal energy. It is not likely that meteors of smaller size can be made observable by improving receivers.

523.5 : 621.396.96 **100**

Diffusion Coefficients from the Rate of Decay of Meteor Trails.—A. A. Weiss. (*Aust. J. Phys.*, June 1955, Vol. 8, No. 2, pp. 279–288.) An estimate of the diffusion coefficient in the meteor zone is obtained by an extension of Huxley's theory of ambipolar diffusion (*Aust. J. sci. Res., Ser. A*, 1952, Vol. 5, p. 10). The absolute value of the diffusion coefficient thus calculated, and its gradient with height, are confirmed by comparison with results of measurements made at Adelaide, using c.w. radar technique at a wavelength of 11·2 m [1424 of 1954 (Robertson et al.)]. The theory appears adequate to account for the observed variation or diffusion coefficient with height.

523.7 **101**

The Identification of Sunspots by means of Chromospheric Faculae.—M. d'Azambuja. (*C. R. Acad. Sci., Paris*, 17th Aug. 1955, Vol. 241, No. 7, pp. 592–594.)

550.372 : 621.396.11 **102**

Influence of Temperature and Humidity on the Electrical Constants of the Ground.—M. Argirovic. (*Ann. Télécommun.*, May 1955, Vol. 10, No. 5, pp. 113–116.)

550.38 : 551.510.535 **103**

Comparison of Records of the Horizontal Component of the Terrestrial Magnetic Field (*K* index) at Kerguelen and at Heard Island.—A. Luchet. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 569–571.) The records confirm that magnetic activity is particularly strong during the equinoxes. The correlation coefficient for the two stations is about 0·7. Ionograms obtained during the strong magnetic variations are characteristic of a highly disturbed ionosphere.

550.380.8 **104**

NOL Vector Airborne Magnetometer Type 2A.—E. O. Schonstedt & H. R. Irons. (*Trans. Amer. geophys. Union*, Feb. 1955, Vol. 36, No. 1, pp. 25–41.) The instrument previously described (719 of 1954) has been modified so as to be suitable for use in all latitudes and to simplify the reduction of results.

550.380.87 **105**

A Recording Magnetic Variometer.—J. H. Meek & F. S. Hector. (*Canad. J. Phys.*, July 1955, Vol. 33, No. 7, pp. 364–368.) Description of an electronic magnetometer designed for continuous measurement of changes in the earth's magnetic field at one place; variations as small as 10^{-5} oersted can be recorded.

550.385 **106**

Notes on the Distribution of *SC in High Latitudes.**—T. Nagata & S. Abe. (*Rep. Ionosphere Res. Japan*, March 1955, Vol. 9, No. 1, pp. 39–44.) An examination of experimental data shows that the equivalent overhead currents for the preliminary reverse impulse in this type of magnetic storm in the northern hemisphere are represented by current flows across the polar cap from the longitude corresponding to 10 h to that corresponding

to 22 h and by the resulting two vortices extending to lower latitudes, a clockwise vortex in the afternoon hemisphere and a weaker counter-clockwise vortex in the forenoon hemisphere.

550.385 : 523.78 **107**

The Effect on Geomagnetism of the Solar Eclipse of 30th June 1954.—J. Egedal & N. Ambolt. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 40–48.) An examination of records of magnetic declination from 11 observatories near the path of totality shows that a maximum magnetic effect occurs at the time of totality, appearing as a diminution of normal daytime departures from the night-time value of the declination. Quantitative agreement with theory is shown.

551.510.52 : 535.325 **108**

Survey of Airborne Microwave Refractometer Measurements.—C. M. Crain. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1405–1411.) Results of measurements made at various places in the U.S.A., over land and off the east and west coasts, are summarized. Variations of the vertical distribution of refractive index are studied in relation to time and place. Particular attention is paid to the fine detail of the refractive-index structure. See also e.g. 2662 of 1954 (Crain et al.).

551.510.52 : 535.325 **109**

Amplitude, Scale and Spectrum of Refractive-Index Inhomogeneities in the First 125 Meters of the Atmosphere.—G. Birnbaum & H. E. Bussey. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1412–1418.) Report of an extensive series of observations made using two refractometers at various levels on a 128-m tower. The correlation between the refractive-index variations and variations of meteorological conditions is studied.

551.510.534 **110**

Seasonal and Latitudinal Temperature Changes in the Ozonosphere.—J. Pressman. (*J. Met.*, Feb. 1955, Vol. 12, No. 1, pp. 87–89.) Computations are presented relevant to the elucidation of the temperature structure in the middle atmosphere. See also 1028 of 1955.

551.510.535 **111**

Hydromagnetic Resonance in Ionospheric Waves.—C. O. Hines. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 14–30.) The large-scale travelling ionospheric disturbances detected by various workers in the F_2 layer may be partially explained as an electron resonance effect, produced when an initial atmospheric disturbance generates natural modes of electromagnetic oscillation, as a result of hydromagnetic coupling.

551.510.535 **112**

Some Features of the E_2 Layer observed at the Ionosphere Field Station, Haringhata, Calcutta.—A. K. Saha & S. Ray. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 107–108.) Photographic records are reproduced showing how the E_2 ionization originates at F_1-layer level, moves downwards and forms a sporadic E layer.

551.510.535 **113**

Recombination and Ion Production from the Total Electron Content.—N. J. Skinner & R. W. Wright. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 105–107.) Revised values are given for the figures suggested previously (1338 of 1955) for the mean recombination coefficient and the mean rate of ion production in the F layer. Results of observations at Ibadan for magnetically quiet and disturbed days are plotted and discussed.

551.510.535 **114**

A Consideration of the Mechanism of Electron Removal in the F_2 Layer of the Ionosphere.—T. Yonezawa. (*Rep. Ionosphere Res. Japan*, March 1955, Vol. 9, No. 1, pp. 17–37.) Possible mechanisms of electron removal are discussed in the light of observations. No satisfactory theory of the phenomenon exists. See also 1036 of 1955.

551.510.535 : 523.78 **115**

Variation of fE_s during Solar Eclipses.—W. Stoffregen. (*Nature, Lond.*, 24th Sept. 1955, Vol. 176, No. 4482, p. 610.) Records obtained by Minnis at Khartoum in 1952 (2298 of 1955) and by Stoffregen in the north of Sweden in 1945 (1778 of 1947) are discussed and compared with observations from various stations in 1954. A decrease of fE_s during the eclipse is found only at places where the eclipse is total or nearly so. The typical eclipse configuration of sun-moon-earth is thought to be in some way responsible for the associated preliminary increase of fE_s.

551.510.535 : 525.624 **116**

The Lunar Semidiurnal Oscillation in the Ionospheric Absorption of 150-kc/s Radio Waves.—A. P. Mitra. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 99–100.) Vertical-incidence absorption measurements made at Pennsylvania State University during 1949–1953 appear to confirm earlier work by Appleton & Beynon (3133 of 1949).

551.510.535 : 550.385 **117**

Geomagnetic Activity and Average Deviations of Daytime F_2-Layer Critical Frequencies in Different Geomagnetic Latitudes.—G. Lange-Hesse. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 49–60. In German.) Analysis of data from six ionospheric sounding stations and one geomagnetic observatory shows a distinct dependence of the average daytime deviations from median values on the geomagnetic latitude, the seasons and the sunspot cycle. The effect on the prediction of ionospheric disturbances is discussed and the reliability of predictions is assessed. See also 2942 of 1954.

551.510.535 : 551.55 **118**

Sporadic-E Movements.—N. C. Gerson. (*J. Met.*, Feb. 1955, Vol. 12, No. 1, pp. 74–80.) Reports of radio amateurs on v.h.f. reception in N. America are consistent with atmospheric movements at a height of 110 km with speeds averaging about 300 km/h. Data on winds at heights up to 120 km, determined by various methods, indicate that at all heights the winds are predominantly from the east during summer and from the west during winter.

551.510.535 : 551.594.5 **119**

The Auroral E-Layer Ionization and the Auroral Luminosity.—A. Omholt. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 73–79.) An empirical relation is established between the photon emission within the negative nitrogen bands of aurorae in zenith and the maximum electron density in the E layer. The recombination coefficient in the layer during aurorae is $> 10^{-7}$ cm³/s. In medium to strong aurorae the mean electron density, deduced from critical frequencies, is between $2{\cdot}10^5$ and $10{\cdot}10^5$ electrons/cm³. V.h.f. echoes observed during aurorae may be explained as backscatter from the ground reflected at low incidence from the auroral E layer.

551.510.535 : 621.396.11 **120**

The Effects of Anisometric Amplitude Patterns in the Measurement of Ionospheric Drifts.—G. J. Phillips & M. Spencer. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 481–492.) Measurement of ionospheric drift by determination of time shifts between fading curves of ionospherically reflected waves received at three spaced points is discussed and the errors involved in assuming that the amplitude pattern on the ground is statistically isometric are evaluated. From 15 recordings of fading curves on 2·4 Mc/s a mean error of 15° in the direction of drift was found, the greatest error being 53°. The errors are not generally systematic.

551.510.535 : 621.396.11 **121**

The Shape of Irregularities in the Upper Ionosphere.—M. Spencer. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 493–503.) Observations of radio stellar scintillations made with three spaced receivers on a frequency of 38 Mc/s show that irregularities in the amplitude pattern on the ground are, regarded statistically, elliptically shaped, the ratio of major to minor axis being at least 5 : 1. The direction of the major axis of the corresponding ellipsoidal ionospheric irregularities appears to be along the lines of force of the earth's magnetic field. Estimates of the drift velocity of ionospheric irregularities based on the assumption that the ionospheric pattern has spherical symmetry are hence subject to error.

551.594.6 **122**

Some Waveforms of Atmospherics and their Use in the Location of Thunderstorms.—F. Horner & C. Clarke. (*J. atmos. terr. Phys.*, Aug. 1955, Vol. 7, Nos. 1/2, pp. 1–13.) The main types of atmospherics waveforms recorded in southern England are illustrated and their use in estimating range is discussed. In an analysis of recordings made during one year, 3% of the waveforms recorded by day and 5% of those by night were suitable for this purpose. Most night-time storms within a distance of 2 000 km produce some waveforms from which range may be determined with an accuracy within ±30%; by day the corresponding distance is 500 km in summer and 1 000 km in winter.

LOCATION AND AIDS TO NAVIGATION

621.396.9 **123**

International Conference on Lighthouses [and other aids to navigation] **at Scheveningen** [31st May–9th June 1955].—C. B. Broersma. (*Tijdschr. ned. Radiogenoot*, July 1955, Vol. 20, No. 4, pp. 257–264.) A report is given of the papers and discussion. Navigation aids discussed included radar, loran, consol, radar beacons, radio-range beacons, radiocommunication.

621.396.93 **124**

Microwave Harbour Beacon.—A. L. P. Milwright. (*Wireless World*, Nov. 1955, Vol. 61, No. 11, pp. 569–570.) A 3-cm-λ pulse transmitter feeds alternately two vertical resonant-slot aerials erected at the harbour entrance and arranged on either side of a separator plate, so that the radiated beams overlap, defining the safe course for entry along a sector 1° wide within which a continuous signal is received. Reception is by a pretuned transistor receiver, coupled to a horn aerial having a horizontal beam width of 16°. On trial the equipment, which is intended for small craft, operated satisfactorily at ranges up to 7 miles.

621.396.933 **125**

TACAN Navigation System shows Bearing and Distance.—(*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 174, 176.) Information is automatically transmitted by a ground installation to an aircraft on interrogation by means of correctly spaced pulses. Bearing accuracy is within ±1° and range is within 600 ft + 0·15% of the distance measured. Operating frequency is around 1 kMc/s. An outline is given of the principles involved.

621.396.96 **126**

Portable Precision Approach Radar.—J. B. Levin. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 154–159.) The system described uses two corner reflectors to determine the touch-down point, the runway centre-line and the elevation reference. The equipment takes six hours to set up and provides touch-down accuracy within ±20 ft.

621.396.96 : 551.577 **127**

Radar Observations of Rain at Poona.—B. K. Gupta, A. M. Mani & S. P. Venkiteshwaran. (*Indian J. Met. Geophys.*, Jan. 1955, Vol. 6, No. 1, pp. 31–40.) Observations made with a search radar Type SCR 717 C operating at 9·1 cm λ are reported and illustrated by photographs.

621.396.96 : 621-526 **128**

The Stability and Time Response of Fast-Operating Closed-Loop Pulsed Radar Circuits.—McDonnell & Perkins. (See 269.)

621.396.963.3 : 621.396.822 **129**

Detection of Pulse Signals in Noise.—D. G. Tucker & J. W. R. Griffiths. (*Wireless Engr*, Nov. 1955, Vol. 32, No. 11, pp. 290–297.) Visual detection of pulse signals against a noise background on an intensity-modulated display is considered; an examination is made of the relation between the probability of detection at any given signal/noise ratio and the measured qualities of the c.r. tube and its phosphor, or of the chemical recorder and its iodized paper. Theory is presented in terms of just-noticeable differences (j.n.ds), defined as the increase of voltage or current which can with certainty cause a just-noticeable increase in visible intensity; the size and number of j.n.ds constitute a subjective measure of the display characteristics. Numerical examples illustrating the theory are presented.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 : 546.482.21 **130**

Influence of Infrared Rays on the Photoconductivity of the Polycrystalline CdS.—S. Yoshimatsu, C. Kanzaki, S. Ibuki & N. Murai. (*J. phys. Soc. Japan*, June 1955, Vol. 10, No. 6, p. 493.) In the specimens investigated, the photocurrent under irradiation by visible light decreased when infrared illumination was added. The dependence of this effect on the wavelength of the infrared radiation is shown graphically for temperatures of 18°, 110° and 150°C.

535.37 + 535.215 **131**

Infrared Stimulation and Quenching of Photoconductivity in Luminescent Powders.—H. Kallmann, B. Kramer & A. Perlmutter. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 391–400.) Continuing previous work (2021 of 1953), measurements are reported on a range of (ZnCd)S phosphors, indicating that photoconductivity excited by ultraviolet or gamma rays may be stored for days and revealed by infrared stimulation, whereas application of the infrared radiation at the same

time as the excitation produces quenching of both fluorescence and photoconductivity. An explanation of the observations is given in terms of the action of the infrared radiation on trapped and valence-band electrons.

535.37 : 537.311.33 **132**

Present-Day Problems in Crystal Luminescence.—M. Curie & D. Curie. (*Cah. Phys.*, March–June 1955, Nos. 55–58, pp. 1–36, 29–48 & 52–80.) A comprehensive survey. The structure of inorganic crystal phosphors, as typified by ZnS, is studied by the methods used for investigating semiconductors generally as well as by specialized luminescence methods. Numerous electrons at the bottom of the conduction band contribute to the luminescence but are not sufficiently displaced to contribute effectively to photoconduction. Radiationless transitions are discussed and a synthesis of various theories is presented. Experimental work, to be effective, should be conducted with transparent films.

535.37 + 537.226.2] : 546.472.21 **133**

Change of the Dielectric Constant of Phosphors under the Influence of Infrared Radiation.—E. E. Bukke. (*Zh. eksp. teor. Fiz.*, April 1955, Vol. 28, No. 4, pp. 507–508.) In all cases when luminescence was increased by illumination with radiation of wavelength $0{\cdot}8\,\mu$ or $1{\cdot}3\,\mu$, the dielectric constant also increased; in cases when the luminescence decreased the dielectric constant remained unchanged. Results for ZnS-Cu,Tm and ZnS.Cds-Cu,Ni are presented graphically; results for other phosphors are tabulated.

535.37 : 546.472.21 **134**

State of Cu Activator in Zinc-Sulphide Phosphors.—A. A. Cherepnev. (*Zh. eksp. teor. Fiz.*, April 1955, Vol. 28, No. 4, pp. 458–462.) Experimental results on ZnS-Cu phosphors prepared by several different methods and excited by ultraviolet radiation indicate that the Cu is in a dispersed state in the phosphor.

535.37 : 546.482.21 **135**

An Experimental Contribution on the Problem of Field Breakdown of CdS Single Crystals.—K. W. Böer & U. Kümmel. (*Ann. Phys., Lpz.*, 15th July 1955, Vol. 16, Nos. 3/4, pp. 181–191.)

535.372 **136**

A Comparison of the Luminescence of Calcium Silicate (Mn, Pb) and Zinc-Beryllium Silicate (Mn).—H. Dziergwa & H. Lange. (*Z. Phys.*, 20th April 1955, Vol. 140, No. 4, pp. 359–369.) Fundamental differences between the emission spectra of the two materials at temperatures between − 180° and + 400°C and between their decay characteristics are discussed.

535.376 **137**

Brightness Waves in the Luminescence of Phosphors excited by Alternating Electric Fields.—H. Gobrecht, D. Hahn & F. W. Seemann. (*Z. Phys.*, 20th April 1955, Vol. 140, No. 4, pp. 432–439.) C.r.o. traces are shown of the brightness variations of electroluminescent phosphors. These exhibit characteristic differences for different phosphors but are not greatly influenced by the frequency, field strength or binding dielectric. The variations are more advanced in phase with respect to the voltage waveform than those of a glow discharge. The asymmetry of the waveforms with increased layer thickness indicates an additional surface effect at the anode.

535.376 : 539.23 **138**

Field-Enhanced Cathodoluminescence in Magnesium Oxide.—J. Woods & D. A. Wright. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 566–569.)

537.226/.227 **139**

On Interactions among Ions of a $BaTiO_3$ Crystal and on its 180° and 90° Type Domain Boundaries.—W. Kinase. (*Progr. theor. Phys.*, May 1955, Vol. 13, No. 5, pp. 529–539.)

537.226 : 621.3.029.6 **140**

Methods for calculating the Dielectric and Magnetic Permeabilities of Artificial Media.—A. L. Mikaelyan. (*Radiotekhnika, Moscow*, Jan 1955, Vol. 10, No. 1, pp. 23–36.) Artificial dielectrics are considered in which the size of the included particles and the distance between them are much smaller than the operating wavelength, so that the properties of the medium are independent of frequency. Several methods are proposed for calculating the dipole moments of conducting and nonconducting particles; the results are tabulated for different shapes of particle. Media can be produced having a refractive index smaller than that of free space.

537.226.2/.3 : 621.317.335.029.6 **141**

Determination of Dielectric Properties from the Brewster Angle of Incidence and the Restored Azimuth at Wavelengths below 3 cm.—Rabenhorst. (See 208.)

537.226.8 : 621.315.616.9 **142**

Creep-Path Formation in Synthetic Materials.—K. Schumacher. (*Elektrotech. Z., Edn A*, 1st June 1955, Vol. 76, No. 11, pp. 369–376.) An experimental investigation is reported. Local heating was produced by means of an electrically heated filament stretched near the specimen, across which a potential was applied. The changes in the specimens up to the time of breakdown were recorded.

537.227 : 547.476.3 **143**

Some Peculiarities of the Polarization of Rochelle Salt exposed to Radioactive Irradiation.—I. S. Zheludev, M. A. Proskurnin, V. A. Yurin & A. S. Boberkin. (*C. R. Acad. Sci. U.R.S.S.*, 11th July 1955, Vol. 103, No. 2, pp. 207–208. In Russian.) The effect of irradiation at an intensity of 10^{19} eV.h^{-1}.g^{-1} is shown by a series of hysteresis oscillograms recorded (*a*) at the beginning of the experiment, (*b*) after 30 min irradiation, (*c*) after 1 h, (*d*) after 2 h, and (*e*) after 13 h 30 min. The polarizing field applied was 1 340 V/cm. As the period of irradiation increases, the loop becomes more and more constricted in the middle, the constriction changes into a straight line the length of which increases until the whole characteristic is linear.

537.228.1 : 534.2-8 **144**

Ultrasonic Velocities in Polarized Barium Titanate Ceramics.—H. B. Huntington & R. D. Southwick. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 667–679.) "Measurements have been made of the ultrasonic velocities in polarized barium titanate ceramic blocks for both compressional and transverse waves, parallel and perpendicular to the axis of polarization. Some variation in compressional velocity with the degree of binding was evident. The largest variation between the velocities for transverse waves causing shear amounted to nearly 12 percent and proved to be accounted for by electromechanical coupling. The compressional velocity parallel to the axis of polarization ran some four percent higher than that at right angles. Here again it appeared that the effect was caused principally by differences in electrical boundary conditions and that the constant field elastic constants varied only slightly with polarization."

537.311.33 **145**

Semiconductors.—(*J. Electronics*, Sept. 1955, Vol. 1, No. 2, pp. 103–230.) This issue is devoted to a series of papers presented at a symposium noted previously [3634 of 1955 (Ross)]; the titles are as follows:—

Speculations on the Energy-Band Structure of Zinc-Blende-Type Crystals.—F. Herman. (pp. 103–114.)

Bond Relationships in Diamond-Type Semiconductors.—C. H. L. Goodman. (pp. 115–121.)

The Validity of the Hydrogen-Like Approximation for Impurity Levels.—G. Rickayzen. (pp. 122–125.)

Photovoltaic and Photoconductive Theory applied to InSb.—T. S. Moss. (pp. 126–133.)

The Photoelectromagnetic Effect in Indium Antimonide.—C. Hilsum, D. J. Oliver & G. Rickayzen. (pp. 134–137.)

Some Implications of the Small Energy Gap and Small Effective Electron Mass in InSb.—J. W. Allen & I. M. Mackintosh. (pp. 138–144.)

Measurements of Diffusion Length in Indium Antimonide.—D. G. Avery & D. P. Jenkins. (pp. 145–151.)

Accurate Measurements of Absorption in Indium Antimonide and Gallium Antimonide.—V. Roberts & J. E. Quarrington. (pp. 152–160.)

A Study of the Conduction Band of InSb.—R. Barrie & J. T. Edmond. (pp. 161–170.)

The Electrical Properties of Indium Antimonide at Low Temperatures.—B. V. Rollin & A. D. Petford. (pp. 171–174.)

The Magneto-resistance Effect in Indium Antimonide.—R. Mansfield. (pp. 175–177.)

A Simple Method to visualize Degeneracy of an Intrinsic Semiconductor.—G. Busch. (pp. 178–180.)

Optical and Electrical Properties of GaAs, InP and GaP.—H. Welker. (pp. 181–185.)

On the Degeneracy Effect in InAs.—R. Talley & F. Stern. (pp. 186–189.)

Preparation and Electrical Properties of CdTe Single Crystals.—F. A. Kröger & D. de Nobel. (pp. 190–202.)

The Preparation, Electrical and Optical Properties of Mg_2Sn.—W. D. Lawson, S. Nielsen, E. H. Putley & V. Roberts. (pp. 203–211.)

Zone Melting of Decomposing Solids.—J. van den Boomgaard, F. A. Kröger & H. J. Vink. (pp. 212–217.)

Thermoelectric Applications of Semiconductors.—H. J. Goldsmid. (pp. 218–222.)

Applications of Indium Antimonide.—I. M. Ross & E. W. Saker. (pp. 223–230.)

537.311.33 **146**

Physical Theory of Semiconductor Surfaces.—C. G. B. Garrett & W. H. Brattain. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 376–387.) Properties associated with the space-charge region and with surface states are discussed in the light of experimental evidence. The theory of the space-charge region is fairly precisely established, but knowledge about the exact structure of the surface states under given chemical conditions is still incomplete. Measurements of surface photoeffect are not alone sufficient to fill the gaps; field-effect experiments with controlled chemical environment would probably give useful results.

537.311.33 **147**

Measurement of Minority Carrier Lifetimes in Semiconductors.—N. F. Durrant. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 562–563.) A modification of the method proposed by Haynes & Westphal (2233 of 1952) is used in which a short pulse of minority carriers is injected into the specimen and made to drift towards the collector by a sweeping field triggered with variable delay by the emitter pulse. The collected pulse is proportional to the number of carriers surviving. The method permits the detection and elimination of errors due to trapping effects and conductivity modulation and gives results consistent within 5%.

537.311.33 **148**

On Lattice Scattering in Homopolar Semiconductors.—J. M. Radcliffe. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428A, pp. 675–680.) A particular solution of the Boltzmann equation for the stationary states of a system subject to electric and magnetic field is obtained, assuming a non-degenerate conduction band of arbitrary shape. The theory is applied in a discussion of the temperature variation of the mobility of holes in Ge and Si.

537.311.33 **149**

Scattering of Electrons and Holes by Charged Donors and Acceptors in Semiconductors.—R. B. Dingle. (*Phil. Mag.*, Aug. 1955, Vol. 46, No. 379, pp. 831–840.) The problem of determining the time of relaxation due to scattering of electrons and holes by charged impurity donors and acceptors in semiconductors is reconsidered and new formulae are derived using an approach which is basically the same as that used by Mott (*Proc. Camb. phil. Soc.*, 1936, Vol. 32, p. 281). Results obtained by these formulae are compared with those derived by other workers.

537.311.33 : 546.28 **150**

Optical Properties of Indium-Doped Silicon.—R. Newman. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 465–467.) Absorption and photoconduction measurements at low temperatures ($< 77°K$) indicate that the ionization energy of In as an impurity in Si is 0·16 eV. Sharp absorption lines observed at 20°K broaden as the temperature rises and practically disappear at 77°K.

537.311.33 : 546.28 **151**

Spin Resonance of Impurity Atoms in Silicon.—C. P. Slichter. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 479–480.) "An explanation is proposed for the weak satellite lines observed in the microwave electron spin resonance of Group V impurity atoms in silicon. The satellites occur halfway between the main hyperfine lines. It is proposed that the satellites represent the resonance of pairs of impurities close enough together for their exchange interaction to be very large compared to the hyperfine coupling. Mathematical details are worked out."

537.311.33 : 546.28 : 539.32 **152**

The Determination of the Elastic Constants of Silicon by Diffuse X-Ray Reflexions.—S. C. Prasad & W. A. Wooster. (*Acta Cryst.*, 10th June 1955, Vol. 8, Part 6, p. 361.)

537.311.33 : 546.289 **153**

Electrical Properties of Germanium Semiconductors at Low Temperatures.—H. Fritzsche. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 406–419.) The low-temperature maximum of Hall coefficient and the saturation of resistivity observed by Hung & Gliessman (1696 of 1955) have been confirmed by measurements over the temperature range 1·5°–300°K, using *n*- and *p*-type crystals with various impurity concentrations. Field effects were excluded, and the anomalous observations were shown not to be due to surface conduction or crystal anisotropy. To explain the results, conduction in at least two energy bands must be assumed, one of which is characterized by very low carrier mobility.

537.311.33 : 546.289 **154**

Optical Properties of Plastically Deformed Germanium.—H. G. Lipson, E. Burstein & P. L. Smith. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 444–445.) Samples of 1-Ω.cm *n*-type Ge were deformed to various degrees by compression at about 700°C. Resistivity and thermoelectric-power measurements indicated that the larger deformations were accompanied by conversion to *p* type. Transmission measurements over the wavelength range 1–15 μ indicated that in all cases the deformation gave rise to a shift of the intrinsic absorption edge towards longer wavelengths, together with an extended tail. A theoretical explanation of the changes is indicated briefly.

537.311.33 : 546.289 **155**

Hall Theory in *n*-type Germanium.—L. Gold. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, p. 596.) Brief interim report of a study of the galvanomagnetic properties of *n*-type Ge based on the value of the scattering time.

537.311.33 : 546.289 **156**

Some Observations on Growth and Etching of Crystals with the Diamond or Zincblende Structure.—E. Billig & P. J. Holmes. (*Acta Cryst.*, 10th June 1955, Vol. 8, Part 6, pp. 353–354.) Characteristic features are described of dendritic plates of Ge and other crystals which have been prepared in the form of long thin lamellae.

537.311.33 : 546.289 : 621.314.632 **157**

Rectification Properties of Metal/Semiconductor Contacts.—E. H. Borneman, R. F. Schwarz & J. J. Stickler. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1021–1028.) Experiments were made using *n*- and *p*-type Ge specimens with various metals plated on. No correlation was found between the reverse saturation current densities and the work function of the metal. For the Ge-metal combinations giving the lowest saturation-current densities, calculations indicate that most of the current is carried by holes, the magnitude of this hole current depending primarily on the diode geometry. This is confirmed by the observed variation of the I/V characteristic with Ge resistivity in the case of Ge-In contacts, and by the temperature variation of the zero-voltage conductance. It is inferred that while it is easy to establish a high barrier to electrons flowing on Ge surfaces, no barrier to hole flow was established with any of the metals used. For a given metal there is an upper limit to the electron current, corresponding to the lowest Ge resistivity.

537.311.33 : 546.46-31 **158**

Electrical Conductivity induced in MgO Crystals by 1·3-MeV Electron Bombardment.—M. A. Pomerantz, R. A. Shatas & J. F. Marshall. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 489–490.)

537.311.33 : 546.561 **159**

Effect of Temperature of Oxidation on the Electrical Conductivity of the Cuprous-Oxide/Copper System.—M. Moldovanova. (*C. R. Acad. Sci. U.R.S.S.*, 11th July 1955, Vol. 103, No. 2, pp. 223–225. In Russian.) The effect of oxidation at temperatures between 980° and 1 040°C was investigated experimentally. Specimens oxidized at 1 000°C were found to have a minimum dissociation energy u, and a minimum value of constant A in the expression for specific conductivity $\sigma = A \exp(-u/kT)$. The conductivity passed through a minimum for oxidation temperatures between 1 000° and 1 020°C.

537.311.33 : 546.682.86 **160**

Electrical Properties of *p*-Type Indium Antimonide at Low Temperatures.—H. Fritzsche & K. Lark-Horovitz. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 400–405.) Measurements over the temperature range 1·5°–370°K indicate anomalies similar to those observed in Ge by Hung & Gliessman (1696 of 1955) for the temperature variation of resistivity and Hall coefficient. The magnetoresistance changes sign from positive to negative as the crystals are cooled through a temperature somewhat lower than that of maximum Hall coefficient; no theory capable of explaining this negative magnetoresistance has yet been advanced.

537.311.33 : 546.682.86 **161**

Effect of Pressure on the Electrical Properties of Indium Antimonide.—D. Long. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 388–390.) Resistivity and Hall-coefficient measurements were made at pressures up to 2 000 atm and temperatures of 0°, 24·3° and 54·3°C, on a sample which was *i*-type down to about 220°K aad *p*-type at lower temperatures. The results indicate that the energy gap increases by $14{\cdot}2 \times 10^{-6}$ eV/atm and the electron mobility decreases by 14% for a pressure increase of 2 000 atm at room temperature.

537.311.33 : 546.682.86 **162**

Effect of Pressure on the Electrical Conductivity of InSb.—R. W. Keyes. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 490–495.) Measurements have been made over the temperature range −78° to +300°C at pressures up to 12 000 kg/cm². The activation energy increases with pressure at a rate $15{\cdot}5 \times 10^{-6}$ eV/(kg/cm²). The electron mobility is approximately inversely proportional to the activation energy, and the hole mobility is independent of pressure. Conclusions are drawn regarding the energy-band structure.

537.311.33 : 546.682.86 **163**

Magnetic Susceptibility of Indium Antimonide.—D. K. Stevens & J. H. Crawford, Jr. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 487–488.) Measurements of the susceptibility of *n*- and *p*-type samples over the temperature range 65°–650°K are reported. The value deduced for the energy gap at 0°K is 0·262 eV, with an effective electron mass of 0·028 m_0.

537.311.33 : 549.351.12 **164**

Electrical Characteristics of Chalcopyrite. The Effect of Surface Treatment on the Rectifying Properties of Crystals.—B. I. Boltaks & N. N. Tarnovski. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 402–409.) Experiments were conducted over a wide range of temperatures to determine the electric and thermoelectric properties of natural and synthetic $CuFeS_2$. The temperature dependence of the electrical conductivity of these materials is of a more complex character than in ordinary impurity semiconductors. By etching the surface it is possible considerably to improve the rectifying properties of the crystals and in a number of cases to obtain static characteristics not inferior to those of Ge and Si detectors.

537.311.33 : 621.314.634 **165**

The Effectiveness of Cadmium Selenide Layers in Selenium Rectifiers.—H. Strosche. (*Z. Phys.*, 20th April 1955, Vol. 140, No. 4, pp. 409–413.) To determine the lowest useful thickness for the intermediate CdSe layer formed in a Se rectifier with a counter electrode containing Cd, measurements were made of the voltage/current characteristics of samples with CdSe or Cd layers evaporated on to a Se-coated plate and with a Bi counter

electrode. No deleterious effects were noticed until the layer thickness dropped below about 10^{-7} cm. If the coating is dense, a monomolecular thickness is sufficient to maintain the rectifying properties.

537.323 **166**

Thermoelectric Properties of Alloys of the Bismuth-Tellurium System.—F. I. Vasenin. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 397–401.) Application of powder-metallurgy pressing and sintering technique enabled much higher values of thermo-e.m.f. to be obtained than hitherto. It was established experimentally that the inversion of the sign of the thermo-e.m.f. in pressed and sintered alloys of the system occurs for compositions in close proximity (within 0·2%) to the compound Bi_2Te_3. It is shown that the theory of Telkes (*J. appl. Phys.*, 1947, Vol. 18, No. 12, pp. 1116–1127) that there exists a second compound in the system with negative thermo-e.m.f., is erroneous.

537.533 **167**

Photoelectric Work Functions of the Borides of Lanthanum, Praseodymium, and Neodymium.—R. W. Decker & D. W. Stebbins. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1004–1006.) Using the DuBridge method of determining the photoelectric threshold, the values 2·74 eV, 3·12 eV and 4·57 eV were found for the work function of LaB_6, PrB_6 and NdB_6 respectively.

538.22 : 546.3-1-711-621-26 **168**

The Structure and Magnetic Properties of the Alloy Mn_3AlC.—R. G. Butters & H. P. Myers. (*Phil. Mag.*, Aug. 1955, Vol. 46, No. 379, pp. 895–902.) In the as-cast state an alloy of composition close to Mn_3AlC is feebly magnetic at room temperature and the magnetic property is retained after homogenization at 1 000°C. The ordered structure is similar to that of Mn_3ZnC (2333 of 1955). The alloy Mn_3AlC is strongly magnetic at low temperatures; the variation of the paramagnetic susceptibility over the range 65°–800°C is different from that of a normal ferromagnetic material.

538.221 **169**

Domain Configurations and Crystallographic Orientation in Grain-Oriented Silicon Steel.—W. S. Paxton & T. G. Nilan. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 994–1000.) The domain structure was investigated by powder-pattern technique and the orientation of the individual domains was determined by the etch-pit optical-goniometer technique. The relations between the two sets of observations are discussed and some conclusions are drawn regarding the three-dimensional domain configuration.

538.221 **170**

Dependence of the Coercive Force on the Density of Some Iron Oxide Powders.—A. H. Morrish & S. P. Yu. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1049–1055.) Fe_3O_4 and γ-Fe_2O_3 are investigated. Calculations are made of the critical size below which the particle comprises a single domain; the value is about 3μ for the major axis of a prolate spheroid of Fe_3O_4 with ratio of major to minor axis 10 : 1, and slightly greater for γ-Fe_2O_3. The observed variation of coercive force with size and shape of particles is consistent with the calculated value of critical size, but the absolute value of the coercive force of the single-domain particles is much smaller than predicted by theory.

538.221 **171**

Magnetic Transformation in MnBi.—R. R. Heikes. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 446–447.) "Manganese bismuth loses its spontaneous magnetization very sharply at 633°K. At the same temperature drastic changes occur in the lattice constants. Previous workers have interpreted both these phenomena as arising from a ferromagnetic-antiferromagnetic transition. The present work indicates that the phase existing above 633°K is actually a ferromagnetic one with a Curie temperature of about 470°K."

538.221 **172**

Multiple Resonances in Cobalt Ferrite.—P. E. Tannenwald. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 463–464.) "Double microwave resonances have been observed in cobalt ferrite when a magnetic field was applied in crystal directions near the hard axis. One resonance occurs before the magnetization vector is lined up with the external magnetic field and another occurs in the aligned state. The experimental results exhibit characteristic features expected before complete line-up and yield, at 90°C, $K_1/M = 2\,200 \pm 200$ and $g = 2{\cdot}7 \pm 0{\cdot}3$."

538.221 **173**

Electrical Conductivity and Seebeck Effect in $Ni_{0{\cdot}80}Fe_{2{\cdot}20}O_4$.—F. J. Morin & T. H. Geballe. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 467–468.) Measurements over a temperature range from about 100° to 350°K indicate thermal hysteresis in the conductivity but not in the Seebeck-effect variation. This suggests that the hysteresis involves the charge-carrier transfer process but not the production of carriers. The activation energy associated with the transfer process is estimated to be 0·10 eV in the high-temperature state and 0·06 eV in the low-temperature state.

538.221 **174**

Electronic Energy Bands in Iron.—J. Callaway. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 500–509.)

538.221 **175**

Ferromagnetism in Noble-Metal Alloys containing Manganese.—F. A. Otter, Jr, P. J. Flanders & E. Klokholm. (*Phys. Rev.*, 15th July 1955, Vol. 99, No. 2, pp. 599–600.)

538.221 **176**

A Study of Domain Structures in Alnico.—L. F. Bates & D. H. Martin. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 537–540.)

538.221 **177**

A Theory of the Uniaxial Ferromagnetic Anisotropy induced by Magnetic Annealing in Cubic Solid Solutions.—S. Taniguchi. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, June 1955, Vol. 7, No. 3, pp. 269–281.) A theory is developed on the basis of van Vleck's model. The results obtained are similar to those of Néel (2983 of 1954).

538.221 **178**

Magnetic Behaviour of Fe-Ni Compacts under Sintering Process.—H. Kojima. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, June 1955, Vol. 7, No. 3, pp. 321–328.) The magnetic properties and density variations of specimens containing between 45% and 85% Ni were investigated as functions of the sintering temperature between 600° and 1 100°C. Results are presented graphically.

538.221 **179**

Demonstration of Magnetization-Reversal Starting Centres in Iron-Nickel Wires under Tension, using the Bitter-Pattern Method.—C. Greiner. (*Ann. Phys., Lpz.*, 15th July 1955, Vol. 16, Nos. 3/4, pp. 176–180.)

538.221 : 539.23 **180**

Energy of the Bloch Walls in Thin [spontaneously magnetized] **Layers.**—L. Néel. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 533–536.) It is shown that as the thickness of the layer is reduced the energy of the Bloch walls first increases, then passes through a maximum and regains its usual value when the layer becomes extremely thin.

538.221 : 539.234 **181**

Preparation of Thin Magnetic Films and their Properties.—M. S. Blois, Jr. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 975–980.) Evaporation technique is described for producing films of ferromagnetic material, particularly Ni-Fe alloys, with thicknesses from 1 000 Å to 100 000 Å and coercivities of 0·1–40 oersted. Magnetic orientation is used to produce a rectangular hysteresis loop. Questions of suitable substrate materials, evaporable dielectrics for use in insulating multilayer films, and control of alloy composition are discussed.

538.221 : 621.3.042.14 **182**

Compressional Stress on Magnetic Laminations.—R. E. Fischell. (*Elect. Engng, N.Y.*, July 1955, Vol. 74, No. 7, p. 585.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1955. Report of an experimental investigation of the effect of stress, such as that produced by clamping, on the magnetic properties of laminations of various materials.

538.221 : 621.318.134 **183**

Ferromagnetic Resonance of Gadolinium Ferrites as a Function of Temperature at 9 000 Mc/s.—J. Paulevé. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 548–550.) The value of the field strength H corresponding to resonance becomes very low in the neighbourhood of 306°K, the compensation temperature. The results of measurements are consistent with the two-sublattice theory of rare-earth ferrites developed by Néel (3275 of 1954); the discontinuity in the value of H is due to reversal of the magnetization of one of the sublattices near the compensation point.

538.221 : 621.318.134 **184**

Dilatometer Thermal Analysis of Samarium Ferrite and Magnetic Transitions of Rare-Earth Ferrites.—G. Guiot-Guillain & X. Waché. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 550–552.)

538.221 : 621.318.134 **185**

Resonance Field Strength for a System of Magnetic Sublattices (Ferrimagnetic Resonance.)—B. Dreyfus. (*C. R. Acad. Sci., Paris*, 8th Aug. 1955, Vol. 241, No. 6, pp. 552–554.) Formulae are presented facilitating calculation of the resonance field strength for ferrites.

538.222/.224 **186**

Some Remarks on S. G. Salikhov's Work.—N. N. Neprimerov. (*Zh. eksp. teor. Fiz.*, June 1955, Vol. 28, No. 6, pp. 719–724.) Detailed critical discussion of recently published papers by Salikhov (e.g. 1833 of 1954) on paramagnetic microwave resonance absorption in metals.

546.3-1-681 **187**

Composition of Binary and Multiple Compounds of [sub-group] **B Metals: Part 1—Systems comprising Gallium with** [sub-group] **B Metals.**—H. Spengler. (*Z. Metallkde*, June 1955, Vol. 46, No. 6, pp. 464–467.)

546.3-1-682 **188**

Indium Alloys.—S. Valentiner. (*Z. Metallkde*, June 1955, Vol. 46, No. 6, pp. 442–449.) A comprehensive review of research on In alloys, having regard to the position of In in the periodic system. Over 86 references.

621.315.61 **189**

Breakdown of Solid Dielectrics in Divergent Fields.—J. H. Mason. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 254–263. Digest, *ibid.*, Part B, Sept. 1955, Vol. 102, No. 5, pp. 725–727.) Experiments with electrode systems in which one electrode is a needle point embedded in polythene or polyisobutylene are reported. Dependence of breakdown stress on the polarity of the point is discussed in relation to the stress-enhanced conductivity and space-charge accumulation. The electric strength of various insulators under industrial conditions is discussed in relation to test data.

621.315.612 **190**

Structure in Vitreous Silicates as shown by Low-Angle Scattering of X-Rays.—L. C. Hoffman & W. O. Statton. (*Nature, Lond.*, 17th Sept. 1955, Vol. 176, No. 4481, pp. 561–562.)

621.315.612.4 **191**

Solid-State Reactions and Dielectric Properties in the System Magnesia Lime Tin-Oxide Titania.—L. W. Coughanour, R. S. Roth, S. Marzullo & F. E. Sennett. (*J. Res. nat. Bur. Stand.*, March 1955, Vol. 54, No. 3, pp. 149–162.) A detailed study is reported of the solid-state reactions occurring among the oxide components in this system and of the effects of composition and temperature on the dielectric properties; the results are presented in numerous tables and graphs.

621.318.134.002.2 **192**

Magnetic Ceramics: Part 1—General Methods of Magnetic Ferrite Preparation.—G. Economos. (*J. Amer. ceram. Soc.*, 1st July 1955, Vol. 38, No. 7, pp. 241–244.) Various methods with commercial possibilities are discussed.

666 : 621.791.3 **193**

Review of High-Temperature Metal-Ceramic Seals.—H. Palmour, III. (*J. electrochem. Soc.*, July 1955, Vol. 102, No. 7, pp. 160C–164C.) Emphasis is on electronic applications. Practical designs are illustrated and properties of several ceramics and glasses are listed.

MATHEMATICS

512.3 **194**

Solution of the Cubic Equation.—E. Astuni. (*Ricerca sci.*, July 1955, Vol. 25, No. 7, pp. 2048–2068.) A method derived from the analysis for coupled circuits under transient conditions (3189 of 1955). Numerical examples are given.

517.512.2 **195**

Convergence and Summation of a Fourier Series corresponding to an Analytical Function.—R. Cazenave. (*Ann. Télécommun.*, May 1955, Vol. 10, No. 5, pp. 102–108.)

519.2 **196**

The Analysis of Non-Markovian Stochastic Processes by the Inclusion of Supplementary Variables.—D. R. Cox. (*Proc. Camb. phil. Soc.*, July 1955, Vol. 51, Part 3, pp. 433–441.)

519.2 **197**

The Probability Distribution of the Amplitude of a Constant Vector plus a Rayleigh-Distributed Vector.—K. A. Norton, L. E. Vogler, W. V. Mansfield & P. J. Short. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1354–1361.) It is emphasized that both amplitude distribution and phase distribution are required to describe a Rayleigh-distributed vector. A summary is presented of physical conditions which must be satisfied for a given phenomenon to exhibit statistical properties of a Rayleigh-distributed vector. The application of the theory to various aspects of radio propagation is indicated.

517 **198**

Reihenentwicklungen in der mathematischen Physik. [Book Review]—J. Lense. Publishers: de Gruyter, Berlin, 1953, 216 pp., D.M. 26. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428A, pp. 764–765.) An account of the use of expansions in terms of orthogonal functions, and of related techniques.

517.564.3 : 518.2 **199**

Bessel Functions of Integer Orders and Large Arguments. [Book Review]—L. Fox. Publishers: University Press, Cambridge, 1954, 28 pp., 6s. 6d. (*Sci. Progr.*, July 1955, Vol. 43, No. 171, p. 526.) Royal Society Shorter Mathematical Tables, No. 3. Auxiliary functions are given permitting computation of $J_n(x)$, $Y_n(x)$, $I_n(x)$, $K_n(x)$ for integral values of n from 0 to 20 and $x > 20$, using in addition merely tables of trigonometric or exponential functions.

MEASUREMENTS AND TEST GEAR

531.761 **200**

New Definition of the Unit of Time and Frequency.—L. Essen. (*Wireless Engr*, Nov. 1955, Vol. 32, No. 11, p. 312.) At the 9th General Assembly of the International Astronomical Union, 1955, the second was defined as 1/31556925·975 of the tropical year for 1900. Some implications of this decision are briefly indicated.

621.317.3 : 537.311.33 **201**

Apparatus for measuring Resistivity and Hall Coefficient of Semiconductors.—T. M. Dauphinee & E. Mooser. (*Rev. sci. Instrum.*, July 1955, Vol. 26, No. 7, pp. 660–664.) Use of the isolating potential-comparator circuit [3064 of 1953 (Dauphinee)] secures the elimination of errors due to thermal e.m.f.s. while permitting the use of d.c. measuring apparatus. Contact and lead resistances do not affect the results.

621.317.3 : 621.372.412 **202**

Spectrum Analyzer for Quartz Crystals.—T. E. McDuffie. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 160–162.) The output from a frequency-sweep oscillator having a sweep range variable up to ± 300 kc/s from a 20 Mc/s mean frequency is mixed with a selected signal from a 20·5–40-Mc/s oscillator. The crystal under test is included in an amplifier circuit fed by the difference-frequency signal, and the detected output is displayed on a c.r.o.

621.317.32 : 621.314.63 **203**

Measurement of [voltage] **Ratios using Dry Rectifiers as Voltage-Dependent Resistors.**—H. Matusche. (*Frequenz*, July 1955, Vol. 9, No. 7, pp. 232–234.) Theory and experimental results are given for circuits based on a voltage divider comprising a linear resistor in series with the rectifier.

621.317.32 : 621.385.832 **204**

Method of measuring the Screen Potential of Cathode-Ray Tubes.—J. R. Young. (*Rev. sci. Instrum.*, July 1955, Vol. 26, No. 7, pp. 647–648.) The Kelvin vibrating-capacitor method is described. A small Al disk arranged parallel to the screen and earthed through a resistor is made to vibrate at mains frequency. When the screen and the disk are at different potentials a.c. flows in the resistor. In typical experiments the screen potential could be determined to within about 5V.

621.317.331 **205**

Residual Effects in the Campbell Bridge Method for the Absolute Measurement of Resistance, and a Note on a New Bridge.—N. F. Astbury. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 279–283. Digest, *ibid.*, Part B, Sept. 1955, Vol. 102, No. 5, pp. 729–730.) Systematic errors associated with coil reversals are shown to be due to uncompensated eddy-current coupling between supply and detector meshes. In the proposed modified bridge this effect can be eliminated without external compensation if three mutual impedances, two of which are nearly equal, are determined instead of two.

621.317.332 **206**

Corrections for Line Losses in [microwave] **Impedance Measurements.**—F. Mayer. (*Ann. Télécommun.*, May 1955, Vol. 10, No. 5, pp. 109–111.) A formula is derived giving the true s.w.r. as a function of the measured s.w.r. and the attenuation constant of the line. A nomogram is hence developed, and its use is illustrated by examples.

621.317.335.029.6 **207**

Microwave Measurements on Low-Loss Dielectrics.—D. Missio. (*Alta Frequenza*, June 1955, Vol. 24, No. 3, pp. 219–237.) Report of measurements made on various dielectrics, at a frequency of about 3 kMc/s and normal temperature, using the method of standing-wave measurements in a short-circuited coaxial line. Various corrections are included in order to improve the accuracy of determination of losses. Results are tabulated and discussed.

621.317.335.029.6 : 537.226.2/.3 **208**

Determination of Dielectric Properties from the Brewster Angle of Incidence and the Restored Azimuth at Wavelengths below 3 cm.—H. Rabenhorst. (*Ann. Phys., Lpz.*, 15th July 1955, Vol. 16, Nos. 3/4, pp. 163–175.) The refractive index and the absorption coefficient are determined from (*a*) the Brewster angle and (*b*) the ratio of intensities of the reflected-wave components parallel and perpendicular to the plane of incidence. The incident wave is plane polarized at 45° to the plane of incidence. From (*a*) and (*b*) the dielectric characteristics can be calculated using the Fresnel relations. Measurements were made at 2·52 cm λ on trolitul, glass, phenol and calcium sulphate. The apparatus is described.

621.317.335.3 : 621.372.413 : 537.562 **209**

Resonant-Cavity Measurements of the Relative Permittivity of a D.C. Discharge.—Foulds. (See 80.)

621.317.335.3.029.6 **210**

A Method for the Determination of the Dielectric Constant of Loss-Free Solid Bodies in Uniform Transmission Lines.—H. Lueg & F. Gemmel. (*Arch. elekt. Übertragung*, July 1955, Vol. 9, No. 7, pp. 307–310.) Measurements at dm λ and cm λ are considered. The test specimen is shaped so as accurately to fill the cross-section of a coaxial line or waveguide, the system then

constituting a line-type transformer. The dielectric constant of the specimen is found from the ratio of the characteristic impedances of the line with and without the specimen, and this ratio is determined from the transformer characteristic without requiring precise knowledge of the position of the line short-circuit or of the specimen.

621.317.382 : 621.373.43 **211**

A Method for determining the Power of a Pulse Generator.—G. F. Novozhenov. (*Radiotekhnika, Moscow*, March 1955, Vol. 10, No. 3, pp. 33–40.) The peak power of a pulse generator can be calculated from the mean power measured by a wattmeter and the 'energy coefficient' of pulses, which is the ratio of the actual pulse energy to the product of pulse period and peak power. This coefficient can be determined from observations of pulses on the screen of a c.r.o. Since these are voltage rather than power pulses, it is necessary to introduce correction factors, and these are calculated for sinusoidal, bell-shaped, trapezoidal and exponential-rise pulses. Curves of the correction factors are also given.

621.317.4 **212**

Measurement of the D.C. Magnetization Curve and of the Hysteresis Loop.—H. Neumann. (*Arch. tech. Messen*, May 1955, No. 232, pp. 105–108.) A brief survey of practical methods.

621.317.4 **213**

A New Astatic Magnetometer for Measurements on Ferromagnetic Sheet in Direct and Alternating Fields.—K. Mellentin & H. Lange. (*Z. Metallkde*, June 1955, Vol. 46, No. 6, pp. 450–456.) The main features of the instrument described are (*a*) use of only one magnetizing coil, and (*b*) the particular arrangement of the system in relation to the specimen. The shape of the latter is such that it becomes uniformly magnetized in a uniform field. Loss measurements can be made very rapidly.

621.317.733 : 621.372.542.2 **214**

A General-Purpose 50-c/s Null Indicator, particularly Suitable for Use with High-Voltage Bridges.—W. P. Baker. (*J. sci. Instrum.*, July 1955, Vol. 32, No. 7, pp. 268–269.) A tapered low-pass *RC* filter, in which every third passive resistance element is replaced by the anode impedance of an amplifying valve, forms the basis of an indicator having a sensitivity of 10–20 μV and a dynamic range of 80 dB, with third-harmonic attenuation 130 : 1.

621.317.742 : 621.372.8 **215**

A Direct-Reading Waveguide Standing-Wave Detector for Use at Low Power Levels.—H. V. Shurmer. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 176–180. Digest, *ibid.*, Part B, July 1955, Vol. 102, No. 4, p. 563.) A directional coupler is used to measure reflected power from the load, which is a function of its v.s.w.r. Errors introduced by the coupler are compensated. The main application is to measurements on crystal rectifiers at 3·2 cm λ, at power levels from 5 to 650 μW.

621.317.755 **216**

Electronically Controlled Electromagnetic Scanning System for High-Voltage Cathode-Ray Oscillograph.—J. Lagasse & J. Clot. (*C. R. Acad. Sci., Paris*, 17th Aug. 1955, Vol. 241, No. 7, pp. 598–600.) The scanning system for a multibeam c.r.o. [1624 of 1954 (Fert et al.)] is discussed. The scanning current is obtained by discharging a capacitance through the scanning coil via a vacuum triode controlled by pulses applied to the grid. Synchronization of blanking and scanning is performed by means of an auxiliary thyratron which operates a delaying circuit on receipt of the primary triggering pulse. Photographic records can be obtained corresponding to a trace speed of 70 mm/μs.

621.317.755 : 621.396.41.029.62 **217**

An Instrument for the Measurement and Display of V.H.F. Network Characteristics.—J. S. Whyte. (*P. O. elect. Engrs' J.*, July 1955, Vol. 48, Part 2, pp. 81–83.) Group-delay/frequency and gain/frequency characteristics are displayed on a c.r.o. A discrimination of 10^{-9} sec is obtainable over a bandwidth of 20 Mc/s centred on 60 Mc/s. Gain/frequency characteristics can be measured with a discrimination of about 0·1 dB.

621.317.76 : 621.395.625 **218**

Measurement of "Wow" and "Flutter".—Dzierzynski. (See 13.)

621.317.761.029.6 **219**

High-Precision [cavity-] **Resonator Frequency Meter for Decimetre Wavelengths.**—H. Groll & G. Pusch. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 462–466.)

621.317.791 **220**

A Quasistatic Multipurpose Meter for Direct and Alternating Voltages.—K. Müller-Lübeck. (*Arch. tech. Messen*, May 1955, No. 232, pp. 113–116.) The universal instrument described, which also includes a facility for capacitance measurements between 50 pF and 20μF, is based on a modified cathode-follower stage. Some of the characteristics of the instrument are presented graphically.

621.317.794 : 621.396.822 **221**

The Sensitivity of Radiometers.—F. V. Bunkin & N. V. Karlov. (*Zh. tekh. Fiz.*, March & April 1955, Vol. 25, Nos. 3 & 4, pp. 430–435 & 733–741.) A precise definition of the sensitivity of a radiometer is given and the value is calculated for a compensation-type radiometer, taking into account the fluctuation of the amplification factor at high frequency. Similar calculations are carried out for a radiometer of the modulation type. In both cases particular attention is given to the effect of the width of the band received.

621.317.794 : 621.396.822 **222**

Null Method of measuring Weak Electrical Fluctuations.—V. S. Troitski. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 478–496.) In this method the amplifier is used only as a null indicator, hence errors due to variations of the amplification factor are completely eliminated. The theory of the method is discussed in application to long and medium waves, and conditions of balance are established for both linear and quadratic detectors. The errors due to various characteristics of the circuit used, as well as to noise in the apparatus itself are discussed in detail.

621.373.1.029.42 **223**

A Sine-Wave Generator for Very Low Frequencies.—W. A. Penton. (*J. sci. Instrum.*, July 1955, Vol. 32, No. 7, pp. 282–283.) Two probes rotating continuously in an electrolyte cell, across which there is a potential difference, generate a sinusoidal voltage with frequency range 0·1–2·0 c/s, and output level variable between 2·5 and 60 V peak to peak. The generator has been used in measurements on high-pass filters to cut off below 0·5 c/s.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.3 : 681.142 **224**

Use of a Computing Machine as a Mechanical Dictionary.—Booth. (See 26.)

531.768 : 546.431.823-31 **225**

Some Developments in Vibration Measurement.—S. Edelman, E. Jones & E. R. Smith. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 728–734.) Two types of $BaTiO_3$ accelerómeter and associated equipment and technique developed at the National Bureau of Standards are described.

534.6-8 **226**

Microacoustic Interferometer using 30-Mc/s Pulses.—R. A. McConnell & W. F. Mruk. (*J. acoust. Soc. Amer.*, July 1955, Vol. 27, No. 4, pp. 672–676.) An instrument for determining ultrasonic velocity and absorption in liquids uses ultrasonic pulses of duration about 10 μs and frequency 30 Mc/s, and detects the reflection from a layer of the test material whose thickness is varied to pass through a resonance condition.

621.3.078/.079 : 681.142 **227**

Industrial Uses of Special-Purpose Computers.—Kuhnel. (See 27.)

621.317.39 : 531.71 **228**

Single-Tube Capacitance Transducer Circuit.—L. Fleming. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 182..190.) A capacitance probe with a resistor in series is connected across the tuned circuit of a r.f. oscillator to give a simple and stable transducer for measurement of mechanical displacements.

621.384.611 **229**

A Variable-Energy Cyclotron.—D. E. Caro, L. H. Martin & J. L. Rouse. (*Aust. J. Phys.*, June 1955, Vol. 8, No. 2, pp. 306–309.) Brief description of a cyclotron designed to accelerate protons in the range 2–12·5 MeV, deuterons in the range 4–6·3 MeV, and α particles in the range 8–12·5 MeV.

621.384.622.2 **230**

The Theory of Electron Beam Loading in Linear Accelerators.—G. Saxon. (*Metrop. Vick. Gaz.*, July 1955, Vol. 26, No. 432, pp. 219–225.) "An analysis is made of the waveguide circuit of a linear accelerator of electrons employing radio-frequency power feedback to show how the power flowing into such an accelerator varies with the beam loading."

PROPAGATION OF WAVES

538.566 : 551.510.535 **231**

Notes on the Propagation of Long-Wave Lightning Atmospherics around the Earth.—H. G. Stäblein. (*Z. angew. Phys.*, June 1955, Vol. 7, No. 6, pp. 290–291.) The discussion presented by Schumann (528 of 1955) is supplemented by an analysis of the propagation of a signal represented by exponential time functions.

538.566.029.43 **232**

The Influence of the Earth's Magnetic Field on the Propagation of Very Long Electrical Waves.—W. O. Schumann. (*Z. angew. Phys.*, June 1955, Vol. 7, No. 6, pp. 284–290.) Analysis is presented in which the ionosphere is regarded as an anisotropic poor conductor. Ordinary and extraordinary wave components penetrate the ionosphere travelling normal to the boundary, with resulting attenuation of and interference with the components travelling in the waveguide formed by the earth and the ionosphere. To satisfy the boundary conditions, both an E mode and an H mode must be propagated in the guide; an original E mode gives rise to an auxiliary H mode, and vice versa. The ratio of the horizontal components at the earth's surface of magnetic field strength perpendicular to and parallel to the propagation direction is a measure of the relative intensities of the E and H modes. A short account of the work is given in *Naturwissenschaften*, Feb. 1955, Vol. 42, No. 4, pp. 91–92.

621.396.11 **233**

Radio Communication by Wave Scattering.—R. L. Smith-Rose. (*Wireless Engr*, Nov. 1955, Vol. 32, No. 11, pp. 287–290.) A brief survey of investigations carried out in America and in Europe; both tropospheric and ionospheric scattering are discussed. Experimental results indicate that over the frequency range from about 25 to 60 Mc/s a signal steady enough for communication with a bandwidth of $\geq$ 3 kc/s, over distances up to about 1 200 miles, is propagated by scattering from the E layer.

621.396.11 **234**

Scatter Propagation.—(*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1173–1526.) The main part of this issue is devoted to a group of papers together providing a comprehensive survey of the state of knowledge on scatter propagation, including both extended-range ionospheric and beyond-horizon tropospheric propagation. The ionospheric mode is of interest for frequencies from about 25 to 60 Mc/s and path lengths of 600 to 1 200 miles; the tropospheric mode is of interest for frequencies from about 100 Mc/s to at least 10 kMc/s and path lengths of 100 miles upwards. Abstracts of several of the papers are given individually; titles of the others are as follows:—

Characteristics of Beyond-the-Horizon Radio Transmission.—K. Bullington. (pp. 1175–1180.)

Aerodynamical Mechanisms producing Electronic-Density Fluctuations in Turbulent Ionized Layers.—R. M. Gallet. (pp. 1240–1252.)

Some Remarks on Scattering from Eddies.—R. A. Silverman. (pp. 1253–1254.)

Factors affecting Spacing of Radio Terminals in a U.H.F. Link.—I. H. Gerks. (pp. 1290–1297.)

Demonstration of Bandwidth Capabilities of Beyond-Horizon Tropospheric Radio Propagation.—W. H. Tidd. (pp. 1297–1299.)

Results of Propagation Test at 505 Mc/s and 4 090 Mc/s on Beyond-Horizon Paths.—K. Bullington, W. J. Inkster & A. L. Durkee. (pp. 1306–1316.)

Some Tropospheric Scatter-Propagation Measurements near the Radio Horizon.—H. B. Janes & P. I. Wells. (pp. 1336–1340.)

The Probability Distribution of the Amplitude of a Constant Vector plus a Rayleigh-Distributed Vector.—K. A. Norton, L. E. Vogler, W. V. Mansfield & P. J. Short. (pp. 1354–1361.) (See 197.)

Trans-horizon Microwave Propagation over Hilly Terrain.—Y. Kurihara. (pp. 1362–1368.)

Tropospheric Overwater Measurements far beyond the Radio Horizon.—L. A. Ames, P. Newman & T. F. Rogers. (pp. 1369–1373.)

Note on Scatter Propagation with a Modified Exponential Correlation.—A. D. Wheelon. (pp. 1381–1383.)

Measurements of the Phase of Radio Waves received over Transmission Paths with Electrical Lengths varying as a result of Atmospheric Turbulence.—J. W. Herbstreit & M. C. Thompson. (pp. 1391–1401.)

Phase-Difference Variations in 9 350-Mc/s Radio Signals arriving at Spaced Antennas.—A. P. Deam & B. M. Fannin. (pp. 1402–1404.)

Some Fading Characteristics of Regular V.H.F. Ionospheric Propagation.—G. R. Sugar. (pp. 1432–1436.)

Line-of-Sight Propagation Phenomena: Part 1—Ray Treatment.—R. B. Muchmore & A. D. Wheelon. (pp. 1437–1449.)

Line-of-Sight Propagation Phenomena: Part 2—Scattered Components.—A. D. Wheelon & R. B. Muchmore. (pp. 1450–1458.)

Near-Field Corrections to Line-of-Sight Propagation.—A. D. Wheelon. (pp. 1459–1466.)

Certain Mode Solutions of Forward Scattering by Meteor Trails.—G. H. Keitel. (pp. 1481–1487.)

621.396.11 **235**

Radio Propagation Prediction considering Scattering Wave on the Earth's Surface.—K. Miya & S. Kanaya. (*Rep. Ionosphere Res. Japan*, March 1955, Vol. 9, No. 1, pp. 1–15.) M.u.f. predictions for multi-hop communication circuits can take into account scattered reflections at the earth's surface by use of a new 'control-line' method, in which the distance of the control points of the older method is taken as the radius of arcs round transmitter and receiver forming the control lines, the m.u.f.s being then determined in the normal way. By including propagation paths other than great circles m.u.f.s may be increased. A comparison of predictions with experience on several commercial circuits confirms the greater efficiency of the new method and shows that land scatter is of chief importance at frequencies below 20 Mc/s, while sea scatter should also be considered in the range 20–30 Mc/s.

621.396.11 : 523.5 **236**

The Role of Meteors in Extended-Range V.H.F. Propagation.—O. G. Villard, Jr, V. R. Eshleman, L. A. Manning & A. M. Peterson. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1473–1481.) The main factors influencing the propagation of continuous radio signals by reflection from meteor ionization trails are reviewed. A method is indicated for calculating the required values of system parameters to maintain the received field strength above the background-noise level for 95% of the time. Measurement results indicate that in some cases forward-scatter propagation in the ionosphere is predominantly governed by meteor ionization; in these cases the performance of existing communication circuits could be improved by appropriate redesign of aerials.

621.396.11 : 551.510.52 **237**

Characteristics of Tropospheric Scattered Fields.—L. G. Trolese. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1300–1305; *Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 117–122.) Measurements made on cm-λ signals transmitted over a 46·3-mile path are compared with values calculated from the theory of Booker & Gordon (1757 of 1950). Tests with a narrow-beam aerial indicate that the scattered field on reception is spread over an angle five to seven times as large as indicated by the theory, assuming that the scale of tropospheric turbulence is large compared to λ. Fading observations support the view that the phenomenon is due to beating between scattered components whose frequencies differ owing to motion of the scatterers.

621.396.11 : 551.510.52 **238**

Investigations of Angular Scattering and Multipath Properties of Tropospheric Propagation of Short Radio Waves beyond the Horizon.—J. H. Chisholm, P. A. Portmann, J. T. deBettencourt & J. F. Roche. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1317–1335.) Report of experiments carried out in the N.E. coastal region of the U.S.A., over paths of lengths 161–188 miles, to determine the possibilities of establishing communication circuits at u.h.f. and microwave frequencies. The results indicate that reliable communication with bandwidths of the order of thousands of Mc/s can be established if power of the order of several kilowatts is used together with highly directional aerials; the tropospheric scattering mechanism is directive and multipath delays are less serious than indicated by previous investigations.

621.396.11 : 551.510.52 **239**

Forward Scattering of Radio Waves by Anisotropic Turbulence.—H. Staras. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1374–1380.) Theory of tropospheric scattering is extended to derive propagation formulae for the case where the scale of turbulence is different in the horizontal and vertical directions. The frequency dependence of the scattered radiation is the same for anisotropic large-scale turbulence as for isotropic. Those radio-system parameters which depend only on the rate of decrease of scattered energy with elevation angle (e.g. vertical correlation function and height gain) are not affected by the anisotropy, while those which depend on the departure from the great-circle plane (e.g. horizontal correlation function) may be substantially affected. The effect on longitudinal correlation function, bandwidth and effective aerial gain is also discussed.

621.396.11 : 551.510.52 **240**

Propagation of Short Radio Waves in a Normally Stratified Troposphere.—T. J. Carroll & R. M. Ring. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1384–1390.) An explanation of the main features of beyond-horizon propagation is presented on the basis of careful calculations assuming absence of turbulence in the troposphere. Internal reflection effects associated with coherent molecular scattering in the atmosphere must be taken into account.

621.396.11 : 551.510.52 **241**

Some Applications of the Monthly Median Refractivity Gradient in Tropospheric Propagation.—B. R. Bean & F. M. Meaney. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1419–1431.) Results of an extensive program of transmission-loss measurements at 100 Mc/s in the U.S.A. are found to indicate consistent correlation with ΔN, the difference between the atmospheric refractive index at the earth's surface and that at a height of 1 km at the mid-point of the propagation path. Six-year average values of ΔN are presented as an aid in predicting annual transmission-loss variations. The observed dependence of transmission loss on ΔN is much greater than indicated by standard propagation theory.

621.396.11 : 551.510.52 **242**

The Use of Angular Distance in estimating Transmission Loss and Fading Range for Propagation through a Turbulent Atmosphere over Irregular Terrain.—K. A. Norton, P. L. Rice & L. E. Vogler. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1488–1526.) A comprehensive investigation of beyond-horizon tropospheric propagation; theoretical formulae are developed on the assumption that the energy may be propagated by diffraction or by forward scattering. The formulae involve the 'angular distance', defined as the angle in the great-circle plane between the radio-horizon rays from transmitting and receiving aerials. For fixed linear and angular distances the nature

of the terrain has a much larger influence on the diffracted-mode intensity than on the scattered-mode intensity. Comparison of calculated and observed values of transmission loss over 122 paths at frequencies between 66 Mc/s and 1·046 kMc/s provides strong evidence in favour of the Weisskopf-Villars theory of tropospheric forward scatter. Theoretical curves of the average value of the path aerial gain to be expected in tropospheric forward-scatter propagation are presented as a function of the angular distance, the asymmetry factor and the free-space gains of the transmitting and receiving aerials.

621.396.11 : 551.510.535 **243**

Radio Transmission at V.H.F. by Scattering and Other Processes in the Lower Ionosphere.—D. K. Bailey, R. Bateman & R. C. Kirby. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1181–1231.) The results of a comprehensive investigation extending over four and a half years are presented; the transmissions used were mainly c.w. Solar wave radiation, corpuscular radiation of presumably solar origin, and meteors are recognized as ionizing agents producing different effects on propagation. The dependence of the received signal strength on time of day, season, solar activity, path details, frequency and scatter angle was studied. The height at which the scattering occurred was determined by a pulse method. The results do not fit existing propagation theories entirely satisfactorily. The significance of the aerial patterns for the results is examined. The possibilities of this type of propagation for communication over distances from about 1 000 to 2 300 km are discussed. Notes are appended by two of the authors and by the editor regretting that certain material has been eliminated from the paper on government instructions.

621.396.11 : 551.510.535 **244**

On the Scattering of Radio Waves by Turbulent Fluctuations of the Atmosphere.—F. Villars & V. F. Weisskopf. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1232–1239.) A theoretical analysis is presented of the mechanism by which v.h.f. signals are transmitted over distances of the order of 10^3 km. It is found that turbulent mixing at the lower edge of the E layer produces fluctuations of electron density large enough to account for the observed signals. The basic assumptions are the existence of an electron-density gradient $> 10^3/cm^3$ per km and a reasonable level of turbulent activity. Errors in previous work (2747 of 1954) are indicated.

621.396.11 : 551.510.535 **245**

Investigations of Scattering and Multipath Properties of Ionospheric Propagation at Radio Frequencies exceeding the M.U.F.—W. G. Abel, J. T. deBettencourt, J. H. Chisholm & J. F. Roche. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1255–1268.) Data obtained from measurements covering about 13 000 h are analysed. Paths used were mostly about 1 000 miles long and situated in medium latitudes. The main frequency used was 49·6 Mc/s, but some measurements were also made on 27·8, 22·9 and 21·6 Mc/s. Short-period fading on 49·6 Mc/s exhibited Rayleigh distribution, long-period fading was essentially Gaussian. The median received signal levels were of the order of 100 dB below free-space values and were higher in winter and summer than in spring and autumn; there was some indication of correlation with sunspot activity and of dependence on direction of polarization. Effective scattering heights of 84–94 km were found in December 1954, using a pulse method. Comparisen of 49·6-Mc/s and 27·8-Mc/s signals indicates that received power probably varies as the inverse third or fourth power of frequency.

621.396.11.029.4/.51 : 551.510.535 : 621.372.8 **246**

The Radial Propagation of Electromagnetic Waves between Two [parallel] **Conducting Planes (Radial Waveguide).** Kaden.—(See 22.)

621.396.11.029.62 **247**

Abnormal Radio Propagation December 3, 1954.—R. F. Jones. (*Met. Mag., Lond.*, July 1955, Vol. 84, No. 997, pp. 225–226.) Abnormally strong signals on 180·4 Mc/s were received at Beddingham, near Lewes, from the B.B.C. station at Sutton Coldfield, distant 147 miles, on the evening of 3rd December 1954. Meteorological records for this period indicate the presence of extraordinarily dry air at levels as low as 2 200 ft, together with a temperature inversion.

621.396.11.029.63 **248**

Transmission Tests at 530 M/cs to Distances beyond Optical Range.—E. Prokott. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 430–437.) Tests were carried out over two transmission paths of nearly 200 km in order to determine the practical requirements for satisfactory communication. A 50-W transmitter was used with an aerial system comprising dipole array and reflectors. The effect of meteorological conditions at the horizon point is noted. The value of radio-path attenuation corresponding to the value of receiver input voltage attained or exceeded during 50% of the test time is estimated as 162 dB. This value is compared with previous results based partly on theory and partly on observations. The results show that optical visibility and freedom from obstructions in the first Fresnel zone are not absolutely essential though reliable operation would be difficult at grazing incidence.

621.396.81 **249**

Long-Period Fading in Medium-Wave Radio Signals.—M. S. Rao & B. R. Rao. (*Nature, Lond.*, 3rd Sept. 1955, Vol. 176, No. 4479, pp. 459–460.) Fading of 1·42-Mc/s signals observed over the 600-km path between Madras and Waltair during May 1954, between 0700 and 0800 h I.S.T., is illustrated by a typical record. The average period of the variations is about 7 min; calculations give a value in good agreement with this.

621.396.812.3 : 551.510.52 **250**

The Rate of Fading in Propagation through a Turbulent Atmosphere.—K. A. Norton, P. L. Rice, H. B. James & A. P. Barsis. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1341–1353.) Fading rate is defined as the number of times per minute that the envelope of the received field strength crosses its median level with a positive slope. The value thus obtained is numerically related to the relevant parameters of the propagation medium under conditions generally satisfied in ionospheric and tropospheric propagation; for beyond-horizon propagation these parameters are the location and shape of the scattering volume and the turbulent and drift velocities of the scatterers. Fading-rate data obtained with 92-Mc/s and 1·046-kMc/s signals over transmission paths of lengths 70 to 394 miles are analysed. Fading over within-sight paths is also discussed. See also 2399 of 1955 (Barsis et al.).

RECEPTION

621.376.23 : 621.396.822 **251**

Signal/Noise Performance of Multiplier (or Correlation) and Addition (or Integrating) Types of Detector.—D. G. Tucker. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 181–190. Digest,

ibid., Part B, July 1955, Vol. 102, No. 4, pp. 558–563.) Discussion is mainly directed to narrow-band pulse systems in which post-detection integration plays little part. The analysis indicates that pulse-to-pulse multiplication is not in general more effective than adding; the slight advantage afforded by the square-law response can be obtained more simply by using square-law rectifiers. When the multiplication is performed before rectification the output contains no direct component in the absence of correlated signals; this is an important advantage when the noise background is varying. Numerical results obtained by various alternative addition and multiplication techniques are tabulated for values of input signal/noise ratio from 0·1 to 4.

621.376.333 : 621.396.62 **252**

The Ratio Detector.—K. R. Sturley. (*Wireless World*, Nov. 1955, Vol. 61, No. 11, pp. 532–537.) The working of the ratio detector in f.m. receivers is simply explained.

621.396.62 : 621.396.3 : 621.376.3 **253**

Automatic Frequency Control in Frequency-Shift Radiotelegraphy.—G. Bronzi. (*Alta Frequenza*, June 1955, Vol. 24, No. 3, pp. 284–287.) A theoretical discussion indicates that receivers for frequency-shift radiotelegraphy should be provided with a.f.c. of the second local oscillator, in order to keep the required bandwidth low.

621.396.62 : 621.396.812.3 **254**

Diversity Reception in U.H.F. Long-Range Communications.—C. L. Mack. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1281–1289.) "Several diversity techniques employed in u.h.f. beyond-the-horizon systems are discussed. Field experience is evaluated in terms of equipment reliability, flexibility and performance. A nonswitching parallel combiner has become the standard military diversity circuit for u.h.f. long-range receivers. The circuit is described and analyzed."

621.396.822 : 621.317.794 **255**

The Sensitivity of Radiometers.—Bunkin & Karlov. (See 221.)

621.396.822 : 621.317.794 **256**

Null Method of measuring Weak Electrical Fluctuations.—Troitski. (See 222.)

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 + 621.376.4 **257**

Quadrature Amplitude-Phase Modulation.—E. M. Vereshchagin. (*Radiotekhnika, Moscow*, March 1955, Vol. 10, No. 3, pp. 72–77.) The energy of sidebands can be increased and the width of the radiated spectrum halved by using the proposed method, in which the carrier is simultaneously subjected to a.m. and ph.m. To do this it is necessary to displace the sidebands so obtained by 90°. Two circuits satisfying the required conditions are considered and the theory of the method is discussed under the following headings: (*a*) frequency spectrum of modulation; (*b*) estimated distortion; (*c*) energy relations and (*d*) effects of interference. Experiments with both circuits gave satisfactory results and confirmed the validity of the theory.

621.376.56 : 621.39 **258**

Methods of reducing the Effects of Noise and increasing Channel Capacity with Pulse-Code Modulation.—F. Benz. (*Arch. elekt. Übertragung*, July & Aug. 1955, Vol. 9, Nos. 7 & 8, pp. 299–305 & 381–387.) Noise entering the r.f. part of the system is considered; its effect is reduced in a pulse system because the pulses occupy only a fraction of the total time. The ratio of theoretical channel capacity C_{th} to actual capacity C is a measure of the noise reduction attained. This ratio can be improved by using the bandwidth-economy system previously described (3415 of 1953) in which a.m. is combined with a type of phase modulation termed 'transverse' modulation. Theory based on that of Shannon (1649 of 1949) is used to determine the probability of confusion between the partial signals and hence to determine that arrangement of individual signals which makes C as nearly as possible equal to C_{th}. Practical circuits for this purpose are described briefly.

621.39.001.11 **259**

On the Limiting Transmission Capacity of a Communication System.—A. A. Kharkevich & E. L. Blokh. (*Radiotekhnika, Moscow*, Feb. 1955, Vol. 10, No. 2, pp. 14–20.) Shannon's geometrical proof of his well-known expression (1) determining the transmission capacity of a communication system (1649 of 1949) is criticized, and a more rigorous proof is developed. The results obtained indicate that expression (1) is valid only at the limit when signal/noise ratio becomes infinite.

621.39.001.11 : 061.3 **260**

Information Theory.—(*Wireless World*, Nov. 1955, Vol. 61, No. 11, pp. 545–546.) A review of papers presented at the conference held at the Royal Institution, London, in 1955.

621.39.001.11 : 621.376.5 **261**

Electrical Pulse Communication Systems: Part 1—Information Theory and Pulse System.—R. Filipowsky. (*J. Brit. Instn Radio Engrs*, Sept. 1955, Vol. 15, No. 9, pp. 451–467.) A survey including an account of the historical development of pulse systems and information theory. The four main classes of system distinguished are communication, data transmission, location and computers. The main features of a system are source, message encoding, signal formation, multiplexing (train formation), wave formation (carrier modulation), transmission over the medium, reception, decoding, destination; individual steps may be omitted in particular systems. The various steps are described.

621.395.44 + 621.397.242 + 621.315.212 **262**

The Position of the Italian Coaxial Network at 31st December 1953.—L. Niccolai. (*Elettrotecnica*, May 1954, Vol. 41, No. 5, pp. 242–250.) The network provides 960 telephone channels in a 4-Mc/s band, together with a television channel a little over 6 Mc/s wide. The average spacing of repeaters is 9·3 km. The cables and repeater characteristics are described.

621.396.41 : 551.510.52 **263**

U.H.F. Long-Range Communication Systems.—G. L. Mellen, W. E. Morrow, A. J. Poté, W. H. Radford & J. B. Wiesner. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1269–1281.) Aspects of scatter propagation relevant to the design of multichannel systems operating over distances of 200 miles or more beyond the horizon are considered. Details of aerial systems, modulation techniques and f.m. transmitting and receiving equipment are discussed. Space-diversity reception is used to overcome fading. System reliability is defined and its value is calculated for a particular system.

621.396.41 : 621.376.3 **264**

Multiplexing F.M. Broadcast Transmitters.—J. H. Bose. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 146–150.) The problems of background noise in

auxiliary f.m. subcarrier channels and cross modulation in the multiplier stages of the transmitter have been solved by narrowing the bandwidth of the early multiplication stages of the main channel and by introducing the auxiliary modulation at a late stage. Field tests have proved that the main f.m. carrier can be modulated to a depth of ± 20 kc/s with a 30-kc/s f.m. subcarrier without affecting quality. See also 849 of 1954 (Armstrong & Bose).

621.396.41 : 621.396.65 **265**

Beyond-Horizon Signals extend Communications.—J. R. Day. (*Electronics*, Oct. 1955, Vol. 28, No. 10, pp. 122–127.) Klystrons giving a power output of 10 kW and aerial systems giving gains of 40 dB over a single dipole, together with diversity reception, make possible u.h.f. multiplex communication circuits with repeater spacings of 175 miles; propagation is by tropospheric forward scatter.

621.396.97 : 621.315.2 : 621.396.8 **266**

The Influence of Delay Distortion and Frequency-Band Limitation on the Quality of Broadcast Transmissions.—E. Belger, E. A. Pavel & H. Rindfleisch. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 445–455.) Report of tests carried out in 1950 and 1951 on the Federal German broadcasting line network. Subjective tests indicate that the tolerable delay in the transmission lines is about 8 ms at the top of the a.f. band, 24 ms at 100 c/s and 120 ms at 50 c/s. The transmission band should go up to at least 10 kc/s, and about 12 kc/s for high-quality transmissions. See also 3709 of 1954 (Belger).

SUBSIDIARY APPARATUS

621-526 : 621.3.015.7 **267**

The Pulse Transfer Function and its Application to Sampling Servo Systems.—R. H. Barker. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 291–292.) Addendum to 1131 of 1953.

621-526 : 621.373.421 **268**

The Frequency-Response Analysis of Nonlinear Systems.—Grensted. (See 56.)

621-526 : 621.396.96 **269**

The Stability and Time Response of Fast-Operating Closed-Loop Pulsed Radar Circuits.—D. McDonnell & W. R. Perkins. (*Proc. Instn elect. Engrs*, Part C, Sept. 1955, Vol. 102, No. 2, pp. 191–202. Digest, *ibid.*, Part B, July 1955, Vol. 102, No. 4, pp. 567–568.) "The paper deals with the stability and time responses of a sampling servo-system typical of a.g.c., a.f.c., range-measuring and overall-feedback circuits used in pulsed radar equipments in which the loop-response time is not many times greater than the pulse-repetition time. The case of a high-speed radar-controlled missile may be such a system. Conditions under which Nyquist plots can be made are given. Expressions for the output both at and between the sampling times are obtained in terms of the input functions of the system. The operation of the system in the presence of noise is considered in the Appendix. A short list of transformations suitable for analysis is included."

621.314.632.1 **270**

The Temperature Dependence of the Capacity of the Copper-Oxide Rectifier.—T. Niimi. (*J. phys. Soc. Japan*, June 1955, Vol. 10, No. 6, pp. 444–453.) The variation of the capacitance at the metal/semiconductor boundary is calculated on the assumption that it is caused by the temperature variation of the free-charge-carrier concentration in the semiconductor. The calculated results are compared with experimental results for the temperature range from −160°C to +60°C.

621.314.634 **271**

Properties of Selenium Rectifiers with Various Impurities.—F. Eckart & A. Schmidt. (*Ann. Phys., Lpz.*, 15th July 1955, Vol. 16, Nos. 3/4, pp. 134–152.) Se rectifiers were prepared with halogen and halogen-compound impurities and their characteristics were investigated. The effect of fluorine and fluorine compounds on the conductivity was nil, that of alkali halides small and that of bromine pronounced. Thallium bromide, copper bromide, tellurium and arsenic have a deleterious effect on the rectifier properties. Results also show that useful rectifiers can be made using very pure Se.

621.314.653 : 537.311.33 **272**

Semiconducting Ignitors for Ignitron Rectifiers.—V. V. Pasynkov. (*Zh. tekh. Fiz.*, March 1955, Vol. 25, No. 3, pp. 377–396.) A detailed report on an experimental investigation is presented, as a result of which methods are proposed for the design and manufacture of ignitors based on silicon carbide.

621.316.722.1 **273**

On the Design of Rectifiers with Electron Stabilization.—G. I. Levitan. (*Radiotekhnika, Moscow*, Feb. 1955, Vol. 10, No. 2, pp. 40–49.) The design of a stabilized rectifier should be divided into two stages: (*a*) calculation of the limits of stability, i.e. of the limiting values of the mains voltage and load current for normal operation of the rectifier, and (*b*) determination of the coefficient of stability. Suitable methods for dealing with stage (*a*) are proposed. Details of the calculation are set out, and the case of the regulating valve with a shunt is discussed separately.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 621.397.8 **274**

The European Television Transmission Network and 'Eurovision 1954'.—F. Kirschstein & H. Bödeker. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 419–425.) Details are given of the network and its operation. The observed transmission faults are described and illustrated by means of oscillograms and photographs. An indication is given of improvement work in hand.

621.397.24 : 621.372.552 : 621.375.2 **275**

A Balanced Equalizer-Amplifier for transmitting Video Signals over Telephone Lines.—J. B. Sewter & D. Wray. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 422–429.) The response of ordinary balanced telephone lines is equalized by controlling the common cathode feedback network of balanced valve pairs. One equalizer unit gives up to 70 dB lift at 3 M/cs. Five corrected telephone links have been connected in tandem to give a video-signal line about 8 miles long.

621.397.242 + 621.395.44 + 621.315.212 **276**

The Position of the Italian Coaxial Network at 31st December 1953.—Niccolai. (See 262.)

621.397.5 **277**

Scientific and Technical Conference on Television Broadcasting.—(*Radiotekhnika, Moscow*, Feb. 1955, Vol. 10, No. 2, pp. 75–77.) Brief report on a conference held in Lenjngrad in December 1954. Twenty-six papers were read dealing with the operation of television centres of the country, colour television, transmitting and receiving tubes, commercial applications of television, long-range reception, etc.

621.397.5 **278**

2½ Years of German Television.—W. Nestel. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 414–418.) An illustrated review.

621.397.61 : 621.372.55 **279**

Differentiating Equalizer for Television Studio Equipment.—A. Krolzig. (*Fernmeldetech. Z.*, Aug. 1955, Vol. 8, No. 8, pp. 426–429.) Advantages and limitations of equipment based on principles described by Gouriet (1936 of 1953) are discussed. Cases of successful use in film transmissions are instanced.

621.397.611.2 **280**

Basic Problems in Film Pickup for TV Broadcasting.—E. M. Gore. (*Elect. Engng, N.Y.*, July 1955, Vol. 74, No. 7, pp. 600–604.) Includes a description of a commercially available system for colour films using three vidicon tubes.

621.397.62 **281**

New Vision A.G.C. System.—S. E. Gent & D. J. S. Westwood. (*Wireless World*, Nov. 1955, Vol. 61, No. 11, pp. 542–544.) A gated a.g.c. system for television receivers is described in which the gating pulse is obtained by differentiating the line synchronizing pulse and using the positive half of the resultant waveform.

621.397.62 : 621.373.43 **282**

A Self-Oscillating Line Timebase Circuit.—A. Boekhorst. (*Philips tech. Commun., Aust.*, 1955, No. 2, pp. 12–18; *Electronic Applic. Bull.*, June 1954, Vol. 15, No. 6, pp. 69–75.) A simple circuit for television receivers uses a single Type-PL81 pentode, with a feedback coil in its control-grid circuit, operating simultaneously as saw-tooth generator and output valve. The synchronization is highly insensitive to noise on the synchronizing signal.

621.397.7 **283**

The Synchronization and Delay Correction of Scattered Television Picture Sources.—A. B. Shone. (*Electronic Engng*, Oct. 1955, Vol. 27, No. 332, pp. 454–457.) The system used in B.B.C. outside broadcasts is described. All synchronizing-signal generators are synchronized to a common tone distributed over telephone circuits. A phase-shifting goniometer in the feed to each generator is used to ensure that the pictures associated with the different generators reach the central switching point in correct relation.

621.397.7 **284**

Operating Experiences at the Lime Grove Television Studios of the British Broadcasting Corporation, London.—D. C. Birkinshaw. (*Arch. elekt. Übertragung*, July 1955, Vol. 9, No. 7, pp. 311–325.) See 1504 of 1955.

621.397.7 : 621.396.11 **285**

Television Coverage of Great Britain.—R. A. Rowden. (*J. Telev. Soc.*, July–Sept. 1955, Vol. 7, No. 11, pp. 457–461, 464–476.) Standards of field strength necessary for satisfactory reception are indicated; properties of the transmitter and of the propagation path affecting coverage are considered. A full account is given of the distribution of field strength in the British television service as at February 1955; planned and possible developments are discussed.

TRANSMISSION

621.376.32 : 621.396.41.029.6 **286**

A Frequency Modulator for Broad-Band Radio Relay Systems.—I. A. Ravenscroft & R. W. White. (*P. O. elect. Engrs' J.*, July 1955, Vol. 48, Part 2, pp. 108–109.) An i.f. modulator based on the ladder-network type of *RC* phase-shift oscillator is described, in which the dynamic input resistances of two grounded-grid valves serve as variable resistance elements. The performance is adequate for monochrome television transmission, or for 240-channel telephony signals.

621.376.4 **287**

A New Method of Phase Modulation.—A. D. Artym. (*Radiotekhnika, Moscow*, Jan. 1955, Vol. 10, No. 1, pp. 53–60.) A method is proposed in which nonlinear modulation of three h.f. voltage vectors is transformed into phase modulation. The theory of the method is discussed and a circuit is described providing phase deviations up to $\pm 300°$; for deviations up to 45° the coefficient of nonlinear distortion does not exceed 0·4%. The parasitic anode modulation is of the order of 2%.

621.396.61 : 621.372.542.2 **288**

A Ten-Kilowatt Low-Pass Filter.—Broad & May. (See 47.)

VALVES AND THERMIONICS

537.5 : 538.56 **289**

Plasma Oscillations in Electron Beams.—K. G. Hernqvist. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1029–1030.) "Self-sustained ion and electron plasma oscillations have been observed simultaneously in an ion neutralized electron beam traveling in a transverse magnetic field. The observed frequencies of oscillation agree with the Langmuir-Tonks theory for plasma oscillations. Electron plasma oscillations occur when the electron plasma frequency equals the gyro frequency of a circular orbit in the magnetic field."

621.314.63 : 621.383.5 : 621.396.822 **290**

Low-Frequency Noise in Illuminated Germanium Diodes.—R. E. Burgess. (*Proc. phys. Soc.*, 1st Aug. 1955, Vol. 68, No. 428B, pp. 569–571.) It is shown theoretically that the current increase in a Ge diode under a given reverse bias when illuminated is independent of the bias voltage and is accompanied by an addition of shot noise which is negligibly small at low frequencies. The comparison of shot-noise behaviour between a dark and an illuminated diode at a given reverse current is inappropriate.

621.314.632 : 546.289 **291**

Forward Characteristic of Germanium Point Contact Rectifiers.—M. Cutler. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 949–954.) The problem is treated by combining the flow equations for the barrier region, derived from emission theory (771 of 1955), with the corresponding equations ('spreading' or 'diffusion' equations) for the flow of carriers in the region beyond the barrier. Numerical solutions are obtained for typical values of the contact parameters. Swanson's assumption (2536 of 1954), that the flow of holes in the barrier region is controlled by diffusion, is discarded; in consequence, the value found for γ at large currents is smaller, the hole concentration at the contact approaches a maximum value proportional to the equilibrium concentration of holes at the surface, and the spreading voltage becomes a linear function of the current.

621.314.632 : 546.289 : 537.312.6 **292**

Thermal Effects in Point-Contact Rectifiers.—R. E. Burgess. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, p. 1058.) Critical comment on notes by Armstrong (1242 of 1954 and 881 of 1955). See also 1948 of 1954 (Armstrong).

621.314.7 **293**

Alloyed-Junction Avalanche Transistors.—S. L. Miller & J. J. Ebers. (*Bell Syst. tech. J.*, Sept. 1955, Vol. 34, No. 5, pp. 883–902.) Minority carriers accelerated in the high-field strength-region of a reverse-biased junction produce hole-electron pairs by collision with atoms. The action may be made cumulative, resulting in avalanche multiplication, which may be controlled by an emitter junction placed close to the multiplying collector junction. The theory of the process is presented and applications to circuits for switching and transmission are discussed. See also 2781 of 1955 (Kidd et al.).

621.314.7 **294**

Variation of Junction-Transistor Current-Amplification Factor with Emitter Current.—L. J. Giacoletto. (*Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, p. 1529.) Using suitably chosen constants, the theory presented by Webster (2798 of 1954) can be experimentally verified for *n-p-n* as well as for *p-n-p* transistors.

621.314.7 : 537.311.33 **295**

The Theoretical Temperature Coefficient of a Junction Transistor.—E. Groschwitz. (*Z. angew. Phys.*, June 1955, Vol. 7, No. 6, pp. 280–282.) The *p-n-p* junction transistor is considered on the basis of Shockley's theory. If the collector voltage is chosen so that the collector operates in the saturation region, the emitter and collector currents are functions of the emitter voltage only and hence the temperature coefficient of the resistances can be determined. Calculations lead to results similar to those obtained for the *p-n* junction (3298 of 1955), where the principal term in the expression for the temperature coefficient is negative and voltage dependent, and the second term is positive and dependent on the carrier lifetime and the width of the base zone.

621.383.27 + 621.385.15 **296**

Statistical Problems of the Electron Multiplier.—L. Yanoshi (Jánossy). (*Zh. eksp. teor. Fiz.*, June 1955, Vol. 28, No. 6, pp. 679–694.) Two problems are considered: (*a*) the probability $P_N^{(k)}(\nu)$ of ν electrons being emitted by the N^{th} electrode if k primary electrons are incident on the first electrode, and (*b*) the distribution of $P(\nu)$, the probability of ν secondary electrons being emitted in response to the incidence of one primary electron, required to obtain a given distribution $P_N(\nu)$ after N steps.

621.383.27 **297**

The Characteristics of Photomultiplier Tubes and their Use for Absorption Measurements.—K. W. Keohane & W. K. Metcalf. (*J. sci. Instrum.*, July 1955, Vol. 32, No. 7, pp. 259–260.) The cathode uniformity of Type-11P21 photomultipliers was examined by using a calibrated electrical attenuator to adjust the output of a comparison photomultiplier to equality with that of the tube under test, which was moved past a slit. The signal strengths used were sufficiently low to avoid fatigue effects. Variations in the characteristics were found to be within the experimental error (of the order of 0·5%); the area of maximum sensitivity of the photocathode was determinable to the same accuracy and the input/output characteristics, in the range 2–0·05 μA, were linear. The greater nonuniformity indicated in the results obtained by Edels and Gambling (*J. sci. Instrum.*, 1954, Vol. 31, p. 121) is considered due to the experimental methods adopted.

621.383.27 **298**

A Method of estimating Photomultiplier Pulse Durations and Shapes.—B. Meltzer, J. A. Lodge & P. L. Holmes. (*J. sci. Instrum.*, July 1955, Vol. 32, No. 7, pp. 270–271.) The spectral output of a photomultiplier being given by the Fourier transforms of the current pulses initiated by individual photons incident on the photocathode, measurements of the output frequency spectrum may be used to show the average shape and duration of the pulses. Some experimental tests are described.

621.383.27 **299**

A Photomultiplier Tube for Scintillation Counting.—R. Champeix, H. Dormont & E. Morilleau. (*Philips tech. Rev.*, March 1955, Vol. 16, No. 9, pp. 250–257.) The tube described has ten stages of secondary emission, giving an overall current amplification of 500 000. The area of the $SbCs_3$ photocathode is 5 cm²; a Wehnelt cylinder focuses the photoelectrons on the first dynode; a staggered arrangement of curved dynodes is used. Steps are taken to keep the inherent noise level low. The tube is suitable for spectroscopy as well as scintillation counting.

621.385.029.6 **300**

Power Flow in Electron Beams.—L. R. Walker. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1031–1033.) An alternative approach to that used by Louisell & Pierce (2145 of 1955) is indicated for determining the flow of microwave power in an electron beam in a weak field.

621.385.032.216 **301**

Measurement of Excess Ba [and/or Sr] **in Practical Oxide Coated Cathodes.**—L. A. Wooten, G. E. Moore & W. G. Guldner. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 937–942.) Over 300 cathodes of various designs were aged for periods up to 50 000 h, tested for emission and then analysed chemically. The complexities and limitations of the available methods of analysis are discussed. The measure of Ba content significant for emission is taken as the amount of H_2 formed on 16 h exposure.

621.385.032.216 **302**

Excess Ba Content of Practical Oxide Coated Cathodes and Thermionic Emission.—G. E. Moore L. A. Wooten & J. Morrison. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 943–948.) Measurements on 125 indirectly heated and 15 directly heated cathodes are reported; methods described in 301 above were used. The evolution of H_2 by uncoated cathodes was also measured. No correlation was observed between the excess Ba content and the emission, and it is inferred that in practice cathode performance is seldom limited by excess Ba.

621.385.1 **303**

On the Space-Charge-Limited Current between Nonsymmetrical Electrodes.—G. D. O'Neill. (*J. appl. Phys.*, Aug. 1955, Vol. 26, No. 8, pp. 1034–1040.) "The validity of employing an equivalent symmetrical anode for expressing the space-charge-limited current between nonsymmetrical electrodes is examined. It is shown that when the equivalent anode is determined by the capacitance, the error in the expression for the current is usually quite small and its approximate magnitude may often be anticipated. Exact expressions for the capacitance of some basic electrode arrangements are given, followed by a brief résumé of corrections required for interpretation of experimental data."

621.385.832 : 621.374.4 **304**

Generation of Harmonics of a Given Fundamental.—Katz & Rau. (See 61.)

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534 : 061.3(47) **305**

Conference on Physical Acoustics and Ultrasonics, Moscow, 3rd-7th March 1955.—(*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 182–190.) Abstracts are given of over 40 papers presented at the conference. See also *Uspekhi fiz. Nauk*, July 1955, Vol. 56, No. 3, pp. 445–456 (Tartakovski).

534.1 **306**

Emission of Sound by the Vibrating Sides of an Arbitrary Wedge.—G. D. Malyuzhinets. (*Akust. Zh.*, April–June & July–Sept. 1955, Vol. 1, Nos. 2 & 3, pp. 144–164 & 226–234.) An exact solution is obtained for the sound-pressure field inside the wedge, using Sommerfeld's integral. Analysis is presented first assuming the whole of each side to vibrate with the same velocity, and next taking account of nonuniform velocity distribution along the sides. The connection is shown between the given problem and that of diffraction by a rigid wedge. The effects of the edge on the radiated power are considered.

534.2-13 : 551.596.1 **307**

Propagation of Sound in Turbulent Atmosphere.—G. Skeib. (*Z. Met.*, Aug. 1955, Vol. 9, No. 8, pp. 225–234.) Measurements were made over paths of lengths 50–150 m at frequencies from 100 c/s to 4 kc/s. From the results, the order of magnitude of the damping due to the turbulence can be determined as a function of frequency and wind velocity, and conclusions can be drawn regarding the structure of the turbulence.

534.2-14 **308**

Investigation of the Sound Shadow in a Medium with a Vertical Gradient of Sound Velocity.—A. N. Barkhatov. (*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 121–125.) An experimental investigation is reported of the propagation of sound in water with a vertical temperature gradient. Results are presented graphically.

534.2-14 **309**

Diffraction of Sound at a Thin Bounded Plate in a Liquid.—L. M. Lyamshev. (*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 138–143.) A calculation is made of the scattering of sound by a thin plate fixed in an infinite rigid screen immersed in a liquid, taking account of the vibrations set up in the plate.

534.232-8 : 537.228.2 **310**

Electrostriction in Liquids and the Generation of Ultrasonics by an Electrostrictive Method.—H. Goetz. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 277–293.)

534.61-8 : 534.522.1 **311**

Useful Ultrasonic Output of a Quartz Radiator in various Liquids [determined] **by an Optical Method.**—S. Parthasarathy, M. Pancholy & C. B. Tipnis. (*Z. Phys.*, 27th Aug. 1955, Vol. 142, No. 1, pp. 14–20.)

534.7 : 621.39 **312**

The Relation between Quantitative Transmission Quality and Transmission Characteristic to the Japanese Language.—T. Miura. (*Rep. elect. Commun. Lab. Japan*, July 1955, Vol. 3, No. 7, pp. 14–24.) Articulation tests were made on women's speech transmitted by microphone to a measuring system. Consideration of the results indicates that a different method of calculating the score is required from that used for other languages.

534.7 : 621.395.813 **313**

Tonal Method of Determining the Intelligibility of Speech Transmitted by Communication Paths.—A. D. Tkachenko. (*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 171–180.) The method described is based on the analysis of results of intelligibility tests in each of twenty frequency bands which together cover the a.f. range from 117 c/s to 10 kc/s. The theory is given and an example of the practical determination of intelligibility is described in some detail. The results obtained by this method were found to be in close agreement with those obtained by the more laborious 'articulation-index' test method.

534.86 : 621.3.018.783 **314**

Nonlinear Distortion of Nonperiodic Signal in an Electroacoustic Path.—A. V. Rimski-Korsakov. (*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 165–170.) The nonlinear response characteristic is approximated

by an exponential polynomial. Expressions are then obtained for the spectral density of the 2nd- and 3rd-order distortion and for the 2nd- to 5th-order distortion of input signals with rectangular or bell-shaped spectral characteristics respectively.

534.874.1 : 621.395.623.7 **315**

Directional Properties of Sound-Dispersive Lenses.—L. N. Bondareva & M. I. Karnovski. (*Akust. Zh.*, April–June 1955, Vol. 1, No. 2, pp. 126–133.) The angular distribution of sound pressure is calculated for plano-ellipsoidal and plano-hyperboloidal acoustic lenses for several values of the refractive index, aperture angle and distance from the virtual focus. The calculated curves are compared with experimental results. Such lenses are useful for improving the directional characteristics of loudspeakers.

621.395.623.743 **316**

The Electrostatic Loudspeaker.—L. J. Bobb & E. C. Gulick. (*Audio*, Sept. 1955, Vol. 39, No. 9, pp. 22–24.) A semicylindrical e.s. loudspeaker for the upper register of a high-fidelity commercial reproducer uses a light-weight polyester 0·0005 in. thick for the diaphragm.

621.395.623.8 **317**

Stereophonic Sound System covers Hollywood Bowl.—O. Berliner. (*Audio*, Aug. 1955, Vol. 39, No. 8, pp. 14–16, 52.) Description of a large open-air sound-reinforcement system.

621.395.625.3 : 621.317.4 **318**

Absolute Measurements in Magnetic Recording.—E. D. Daniel & P. E. Axon. (*B.B.C. Engng Div. Monographs*, Sept. 1955, No. 2, pp. 1–9.) Measurement of the absolute magnitude of the surface induction of the tape is discussed in relation to the standardization of recorded level. Consideration is given to the possibility of measuring the absolute sensitivity of the various parts of the recording-reproducing chain, with a view to formulating an unequivocal representation of tape sensitivity.

AERIALS AND TRANSMISSION LINES

621.315.212.011.21 **319**

The Choice of Impedance for Coaxial Radio-Frequency Cables.—W. T. Blackband. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 804–814.) Cable design is considered in relation to attenuation per unit length, voltage rating and power ratings based on thermal and voltage limitations. A method is presented for determining the optimum proportioning to satisfy a specification of two or more cable properties. The criterion of a specified attenuation with minimum diameter is satisfactory for practical purposes. The best value of characteristic impedance is 75 Ω for low-loss air-spaced cables and 50 Ω for general-purpose thermoplastic cables. See also 2299 of 1954 (Gutzmann).

621.372 **320**

The Launching of a Plane Surface Wave.—G. J. Rich. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 824–825.) Discussion on 1548 of 1955.

621.372.029.6 **321**

Microwave High-Speed Continuous Phase Shifter.—W. Sichak & D. J. Levine. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1661–1663.) A phase shifter is described comprising two helices, wound in the same sense, inside a circular waveguide, one of the helices being rotated at a desired rate. A model designed for operation at 9·4 Mc/s is 5½ in. long and 1 in. in diameter, excluding the motor drive, and rotates at 3 600 r.p.m.

621.372.2 **322**

Reflection in Helical Lines at a Change in the Helix Pitch: Part 1—Calculation Results and their Physical Significance.—G. Piefke. (*Arch. elekt. Übertragung*, Aug. 1955, Vol. 9, No. 8, pp. 369–374.) An investigation relevant to the design of travelling-wave valves with band-pass characteristics. Analysis taking account of higher modes is simplified by assuming the pitch in one portion of the helix to have the limiting value 90°. When the changes of pitch are not too great, the phase angles, which depend on all the modes, can be neglected, and only the fundamental wave considered.

621.372.8 : 621.318.134 **323**

Magneto-optical Phenomena in a Rectangular Waveguide containing a Ferrite Plate.—A. L. Mikaelyan. (*Bull. Acad. Sci. U.R.S.S., sér. tech. Sci.*, March 1955, No. 3, pp. 139–149. In Russian.) Results are presented graphically of calculations of the propagation characteristics of *H*-waves, of frequency of the order of 10 kMc/s, in a waveguide partly filled with ferrite, in the presence of a transverse magnetic field. The effects of position and thickness of the ferrite plate, the dielectric constant, magnetization, frequency and waveguide dimensions are considered. Propagation in waveguides containing a ferrite/dielectric composite plate or a ferrite plate and isotropic layers is also considered. See also 925 of 1955.

621.372.8 : 621.318.134 **324**

Theory of New Ferrite Modes in Rectangular Waveguide.—B. Lax & K. J. Button. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1184–1185.) Exact theory is presented for propagation in a waveguide containing one or two transversely magnetized ferrite slabs adjacent to the walls.

621.372.8 : 621.318.134 **325**

New Ferrite Mode Configurations and their Applications.—B. Lax & K. J. Button. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1186–1187.) The mode configurations of the electric fields corresponding to the various solutions given in 324 above are illustrated.

621.396.67 : 621.396.932 **326**

The Use of a Ring Array as a Skip-Range Antenna.—J. D. Tillman, W. T. Patton, C. E. Blakely & F. V. Schultz. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1655–1660.) The problem discussed is the development of a shore aerial for shore-to-ship communication at distances of 40–500 miles. An omnidirectional ring array of vertical $\lambda/4$ aerials is used with alternative excitation so as to concentrate the energy (*a*) into the ground wave for daytime communication and for communication over distances less than about 200 miles at night, or (*b*) into the sky wave for night-time communication over greater distances. Range calculations are presented based on a 3-kW transmitter and an operating frequency of 3 Mc/s.

621.396.67 : 621.866 **327**

Special Winches for the New Aerial Installation of the Schwarzenburg Short-Wave Transmitter.—H. R. Lerch. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Aug. 1955, Vol. 33, No. 8, pp. 312–316. In German and French.) The aerial system discussed comprises seven masts of heights between 40 and 120 m forming a

three-arm star with two masts supporting flat-top aerials in each arm around a central mast. Instead of the customary stationary winch associated with each mast, two mobile winches were used; these are described and illustrated; they have given satisfactory service since autumn 1953.

621.396.67.012.12 **328**

Helicopter measures Antenna Patterns.—H. Brueckmann. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 134–136.) The measuring equipment described comprises a small signal source located at the centre of a dipole aerial suspended from the helicopter by means of a nylon string; a constant-intensity signal is transmitted and the helicopter flies in circles round the aerial under test, ground equipment being provided to track the helicopter position. The radiation pattern of a complex aerial system can be plotted in under 3 h, accurate to within 20%. Sources of error are discussed.

621.396.67.029.62 : 621.397.62 **329**

Dual-Band Television Aerials.—F. R. W. Strafford. (*Wireless World*, Nov. & Dec. 1955, Vol. 61, Nos. 11 & 12, pp. 539–542 & 607–610.) The inefficiency of band-I dipole aerials on band-III frequencies and the results of various modifications are shown by curves obtained experimentally.

621.396.677.3 : 621.396.93 **330**

Design for Wide-Aperture Direction Finders.—R. C. Benoit, Jr, & M. W. Furlow. (*Tele-Tech & Electronic Ind.*, Sept. 1955, Vol. 14, No. 9, pp. 60–62 ..108.) The aerial system of the U.S.A.F. direction finder AN/GRD-9 is described. It is developed from the German Wullenweber u.h.f. system and produces a pattern equivalent to that of a rotating planar array by means of a number of fixed elements arranged in a circle, with an inner circle of reflectors, the signals being picked up by a rotating commutator and appropriately delayed so that all arrive in phase at a common mixing point. For the experimental model described the frequency range covered is wider than 225–400 Mc/s, the beam width being 6°; bearings can be determined to within ±1°.

621.396.677.71 **331**

Radiation Characteristics of Axial Slots on a Conducting Cylinder.—J. R. Wait. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, pp. 316–323.) "An extensive set of radiation patterns is presented for a narrow axial slot on a circular conducting cylinder of infinite length with a circumference up to 21 wavelengths. The results are also applicable to arrays of axial slots with an arbitrary distribution of transverse voltage. The effect of finite slot width is discussed and the external conductance of the slot is also considered."

621.396.677.833 **332**

Determination of Aperture Phase Errors in Microwave Reflectors.—D. K. Cheng & P. Grusauskas. (*J. Franklin Inst.*, Aug. 1955, Vol. 260, No. 2, pp. 99–105.) "Using the vector notation of differential geometry, a general expression is obtained for the phase error in an aperture plane of any given reflector when the equation of the incident wavefront is known. For the special case of a point source, the formula can be readily applied to determine the aperture phase distribution for any source location."

AUTOMATIC COMPUTERS

681.142 **333**

An Attempt to simplify Coding for the Manchester Electronic Computer.—R. A. Brooker. (*Brit. J. appl. Phys.*, Sept. 1955, Vol. 6, No. 9, pp. 307–311.) Two main simplifications are made, both at the cost of increased machine time. To ensure that all quantities involved in a calculation are represented to the required degree of accuracy, every number occurring is associated with its own scale factor. Again, in using the two levels of storage provided, arrangements are made so that 'instructions' are written out as if for a one-level store. A program in the simplified form is described.

681.142 **334**

A Magslip Isograph.—G. M. Parker & R. W. Williams. (*J. sci. Instrum.*, Sept. 1955, Vol. 32, No. 9, pp. 332–335.) The terms of a polynomial equation to be solved are represented by alternating voltages of varying time phases obtained from magslip transmitters. The instrument described is capable of solving sixth-degree equations having real coefficients, and may be used for the evaluation of polynomials.

681.142 **335**

A Flutter Computer with Low Gain Amplifiers.—K. E. Wood & I. V. Hansford. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 477–481.) Low-gain d.c. amplifiers are used, thus avoiding drift troubles. The principle of the computer is to shift all the poles of the solution to the left in the complex p plane, $F(p)$ being a stable solution of the problem. The method is useful in low-stiffness problems.

681.142 : 621.3.002.2 **336**

Basic Chassis for Experimental Work.—N. M. Emslie. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 166–168.) Design details are given for a universal unit for use in computers, for manufacture in small quantities.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.012 **337**

An Approximate Method for obtaining Transient Response from Frequency Response.—H. H. Rosenbrock. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 744–752.) A rapid method for finding the transient response of a linear system whose frequency response is known numerically, but not as an analytical function, involves use of a specially constructed transparent cursor. The technique can also be used to deal with the inverse problem or to derive an analytical function representing the behaviour of a system of which either the frequency response or the transient response has been measured.

621.314.22 : 621.372.5 **338**

Transformer Design on Insertion-Loss Principles.—H. Schilling. (*Telefunken Ztg.*, March 1955, Vol. 28, No. 107, pp. 5–14. English summary, pp. 58–59.) Wide-band-transformer data can be calculated using the normalized values for the circuit elements of high-pass and low-pass networks derived from insertion-loss theory for reactive quadripoles, examples of which are tabulated. By considering the transformer equivalent circuit as part of a Tchebycheff filter network of higher order, significant improvements can be made in the transmission characteristic. By introducing special low-permittivity layers between windings further improvement is possible.

621.318.43 : 621.318.134 **339**

Perpendicularly Superposed Magnetic Fields.—R. Heartz & H. O. Buelteman, Jr. (*Elect. Engng, N.Y.*, Aug. 1955, Vol. 74, No. 8, p. 661.) Digest of a paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1955. Theory is outlined for a 'cross-field reactor' comprising a hollow ferrite toroid carrying one annular winding internally and one

toroidal winding externally. The device can be used as a low-level d.c. converter or modulator, as a variable inductance, or as a frequency multiplier or divider.

621.318.43 : 621.375.3 **340**

Analysis of Optimum [core] **Shape for Magnetic Amplifiers.**—B. D. Bedford, C. H. Willis & G. C. Dodson. (*Elect. Engng, N.Y.*, Aug. 1955, Vol. 74, No. 8, p. 694.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, 1955.

621.318.57 : 621.374.32 **341**

Composite Multistable Circuit with Natural Quinary Cycle.—R. Favre. (*Helv. phys. Acta*, 31st Aug. 1955, Vol. 28, No. 4, pp. 442–446. In French.) A circuit composed of binary and ternary stages is used, based on design principles described previously (3485 of 1954). Details are given of a decade unit embodying the circuit.

621.37/.39(083.74) **342**

NBS-BuAer Preferred Circuits Program.—(*Tech. News Bull. nat. Bur. Stand.*, Oct. 1955, Vol. 39, No. 10, pp. 134–136.) Report of investigations made by the N.B.S., in conjunction with the U.S. Navy Bureau of Aeronautics, of the feasibility of standardizing the circuits used in electronic equipment. A similar account is also given in *Elect. J.*, 9th Dec. 1955, Vol. 155, No. 24, pp. 1939–1941.

621.372 **343**

Topological and Dynamical Invariant Theory of an Electrical Network.—T. C. Doyle. (*J. Math. Phys.*, July 1955, Vol. 34, No. 2, pp. 81–94.)

621.372.029.6 : 621.3.018.75 **344**

Linear Transmission of Pulses at Centimetre Wavelengths.—E. Ledinegg. (*Arch. elekt. Übertragung*, Aug. 1955, Vol. 9, No. 8, pp. 363–368.) Analysis for the transmission of pulses of arbitrary shape by waveguide and cavity-resonator systems is based on use of Laplace transforms. Using theory presented previously [1700 of 1954 (Ledinegg & Urban)] a calculation is made of the transfer function for a system of weakly coupled cavity resonators.

621.372.029.64 : 538.569.4 **345**

The Maser—New Type of Microwave Amplifier, Frequency Standard, and Spectrometer.—Gordon, Zeiger & Townes. (See 403.)

621.372.412 : 549.514.51 **346**

Influence of the Order of Overtone on the Temperature Coefficient of Frequency of AT-Type Quartz Resonators.—R. Bechmann. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1667–1668.)

621.372.413 : 538.221 : 621.318.134 **347**

Magnetic Fields in Small Ferrite Bodies with Applications to Microwave Cavities containing Such Bodies.—A. D. Berk & B. A. Lengyel. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1587–1591.) An analysis is presented of the field inside small spheres and cylinders of ferrite excited by circularly or linearly polarized magnetic fields in cavities. The formulae derived are used to calculate the detuning and change of Q value of the cavity on introducing the ferrite body, or conversely to determine the ferrite permeability tensor from the observed changes in the cavity characteristics.

621.372.413.029.64 : 538.569.4 **348**

Increasing the Q Factor of the Cavity Resonator by Regeneration.—N. G. Basov, V. G. Veselago & M. E. Zhabotinski. (*Zh. eksp. teor. Fiz.*, Feb. 1955, Vol. 28, No. 2, p. 242.) A brief note on the cavity resonator used in conjunction with the molecular-beam oscillator [100 of 1955 (Gordon et al.) and 2275 of 1955 (Basov & Prokhorov)]. A Q factor of 5×10^6 has been obtained for periods of up to 20 min.

621.372.5 **349**

The Graphical Determination of the Geometrical Parameters of Loss-Free Linear Quadripoles.—J. de Buhr. (*Arch. elekt. Übertragung*, Aug. 1955, Vol. 9, No. 8, pp. 350–354.) The methods described previously (2864 and 3523 of 1955) are applied to determine the iterative impedance and iterative transfer constants.

621.372.5 : 538.652 **350**

Application of the Wiedemann Effect to the Magnetostrictive Coupling of Crossed Coils.—U. F. Gianola. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1152–1157.) An electromechanical quadripole is described comprising a tubular magnetostrictive ferrite core carrying crossed coils, one wound toroidally and the other as an external helix. Theory is presented in terms of an equivalent circuit. The device can be used for filtering, gating, phase-reversing, etc. Successful experiments with ferroxcube IV E cores operating at frequencies between 25 and 150 kc/s are reported.

621.372.54 **351**

Catalogue of Power-Law and Tchebycheff-Type Filters up to Order n = 5.—E. Glowatzki. (*Telefunken Ztg.*, March 1955, Vol. 28, No. 107, pp. 15–22. English summary, p. 59.) Four tables give the circuit diagrams and the normalized values of the circuit elements in maximally-flat-response and Tchebycheff-type filters (*a*) terminated, and (*b*) with a short or open circuit at one end, for different values of the pass-band reflection coefficient. Corresponding attenuation characteristics are given in 15 diagrams. The application of the tables is illustrated in five numerical examples. See also 1903 of 1955.

621.372.54.029.3 : 621.372.57 **352**

Electrically-Controlled Audio Filters.—L. O. Dolanský. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1580–1586; *Convention Record Inst. Radio Engrs*, 1955, Vol. 3, Part 7, pp. 41–48.) Design theory based on the work of Linvill (1711 of 1954) is presented for a low-pass and a high-pass filter both having cut-off frequencies continuously variable between 200 c/s and 1 kc/s. The cut-off characteristic may be controlled by the a.f. signal for investigating the structure of speech signals. Experimental results are reported.

621.372.543.2.029.62/.63 **353**

U.H.F. Multiplexer uses Selective Couplers.—H. J. Carlin. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 152–155.) An arrangement is described comprising directional couplers incorporating filter properties combined to form a system enabling several transmitters and receivers to be operated with a single aerial in the frequency range 225–400 Mc/s. A coaxial-line construction with tuned cavity resonator is used. A four-coupler system with separation of 3 Mc/s between channels can provide adjacent-channel reduction of 60 dB with insertion loss of 1 dB.

621.372.55 **354**

Equivalent Equalizer Networks.—R. O. Rowlands. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, pp. 323–327.) The various types of frequency-response curves obtainable with practical networks of the derivative-equalizer type [1936 of 1953 (Gouriet)] are analysed and the equivalent constant-resistance networks are determined.

621.373.4 : 621.316.726 **355**

Improvement of Stabilized Pound Oscillator.—J. Hervé. (*C. R. Acad. Sci., Paris*, 19th Sept. 1955, Vol. 241, No. 12, pp. 746–749.) Adjustment of the oscillator is facilitated by means of a sawtooth generator with switching arrangements such that it can be interpolated at various points in the circuit, the attainment of the desired oscillator characteristic being indicated on a c.r.o.

621.373.431.2 : 621.373.52 : 621.314.7 **356**

Junction-Transistor Blocking Oscillators.—J. G. Linvill & R. H. Mattson. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1632–1639.) Circuits have been designed producing pulses with rise times $< 0{\cdot}1\ \mu s$, using transistors with α-cut-off frequencies of a few Mc/s. Details of the regenerative transformer coupling are discussed. Triggering requirements and the effects of loading are evaluated. Experimental results support the theory.

621.373.444 **357**

Stabilization of Pulse Duration in Monostable Multivibrators.—A. C. Luther, Jr. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 403–422.) Pulse-duration stabilization of triggered circuits by d.c. feedback is described. Practical circuits suitable for frequency division and pulse generation in television equipment are illustrated.

621.373.52 : 621.314.7 **358**

Transistor Pulse Generators.—W. S. Eckess, J. E. Deavenport & K. I. Sherman. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 132–133.) Numerical design data are given for four circuits using Ge junction transistors and one using a Si transistor. Pulse rise times as low as $0{\cdot}1\ \mu s$ are attainable at repetition frequencies up to 50 000 pulses/sec; pulse durations are variable from 0·4 to $9\ \mu s$.

621.374.4 : 621.318.435 : 621.396.96 **359**

Saturable-Reactor Frequency Divider.—G. W. G. Court & C. I. C. Scollay. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, pp. 328–329.) A saturable reactor is used in conjunction with a *RC* network to provide a circuit capable of producing a pulse output at the frequency, or a submultiple of the frequency, of a sinusoidal input. A circuit providing synchronizing pulses for a radar modulator at half the frequency of the 400-c/s power supply is described.

621.375.2.024 **360**

Automatic Drift Compensation in D.C. Amplifiers.—I. Cederbaum & P. Balaban. (*Rev. sci. Instrum.*, Aug. 1955, Vol. 26, No. 8, pp. 745–747.) The circuit discussed is similar to that described by Offner (3511 of 1954). It may be used in systems where periodic interruption of the input and noncontinuous compensation are permissible, as in analogue computers, sampling amplifers, etc.

621.375.221.2 **361**

Optimum Tube Utilization in Cascaded Distributed Amplifiers.—A. I. Talkin & J. V. Cuneo. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1668–1669.) Analysis is presented taking account of the bandwidth-narrowing factor introduced by cascading stages; this factor is evaluated for an amplifier using constant-*R* bridged-T lines. A numerical example is discussed.

621.375.227 **362**

Rejection Factor of Difference Amplifiers.—G. Klein. (*Philips Res. Rep.*, Aug. 1955, Vol. 10, No. 4, pp. 241–259.) Analysis shows that the rejection factor of a differential amplifier can be made arbitrarily large without necessitating pre-selection of valves or exact equality of the two halves of the circuit. The theory is supported by experimental results. The parameter termed 'rejection factor' is the same as that termed 'transmission factor' by Parnum (1636 of 1950).

621.375.3 **363**

Magnetic Amplifiers as Control Components.—W. La Pierre. (*Product Engng*, Aug. 1955, Vol. 26, No. 8, pp. 129–133.) The advantages and limitations of magnetic amplifiers for voltage and current control, switching and amplifying are compared with those of various other devices; important properties are tabulated.

621.375.3 : 621.383.5 : 621.314.63 **364**

A Germanium Diffused-Junction Photoelectric Cell.—Waddell, Mayer & Kaye. (See 615.)

621.375.327.024 **365**

Low Level Magnetic Amplifier.—F. Gourash. (*Tele-Tech & Electronic Ind.*, Aug. 1955, Vol. 14, No. 8, pp. 90–91 .. 160.) A two-stage push-pull d.c. amplifier is described in which a high degree of negative feedback is used to obtain stability and linearity, with high input impedance. By careful balancing of components the zero drift, measured in terms of input power, is reduced to the order of 10^{-12} W.

621.375.4 : 621.314.7 **366**

Transistor Power Amplifiers.—R. A. Hilbourne & D. D. Jones. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 763–774. Discussion, pp. 786–792.) Discussion of conditions for *p-n-p* junction transistors handling sinusoidal signals indicates that the maximum possible output is not necessarily limited by the maximum allowable collector dissipation; limitations set by the variation of current gain with emitter current become particularly significant in class-B amplifiers because of their very high efficiencies. Push-pull class-B operation is preferred to class-A; of the three possible basic connections the common-collector arrangement is preferred as providing the best compromise between gain and distortion and permitting the simplest design of output transformer. No great advantage is found by using complementary *n-p-n* and *p-n-p* transistors. Applications involving nonsinusoidal signals are discussed briefly.

621.375.4 : 621.314.7 **367**

Predictable Design of Transistor Amplifiers.—R. B. Hurley. (*Tele-Tech & Electronic Ind.*, Aug. 1955, Vol. 14, No. 8, pp. 74–75 .. 168.) The transfer characteristic of a multistage low-frequency amplifier using junction transistors may be made independent of the transistor characteristics by the use of degenerative current feedback, at the same time improving linearity. The importance of stable biasing arrangements is emphasized.

621.375.4 : 621.314.7 **368**

Simplified Design Procedures for Tuned Transistor Amplifiers.—C. C. Cheng. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 339–359.)

621.375.4 : 621.314.7 **369**

Maximum Power Transfer in Transistor Amplifiers.—G. L. Fougere. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 492–493.) The theoretical treatment of transistor-amplifier performance is simplified by restricting consideration to the condition of maximum power transfer, when it is possible to make a rapid

assessment of the available power gain for a particular configuration, in terms of the transistor parameters. Curves show the relation between maximum power gain, current gain and transistor constants for grounded-base and grounded-collector arrangements.

621.375.9 : 621.385.032.216 **370**

Properties of Pore Conductors.—Forman. (See 630.)

GENERAL PHYSICS

530.112 **371**

Some Considerations regarding the Principle of Phase Invariance.—F. A. Kaempffer. (*Canad. J. Phys.*, Aug. 1955, Vol. 33, No. 8, pp. 436–440.) It is shown that the conservation laws characterizing the ether can be derived from the principle of phase invariance provided a complex field is used to describe the ether.

530.145 : 539.153 : 548.0 **372**

Tamm Equations of State of Electrons at the Surface of a Crystal and Surface Oscillations of Lattice Atoms.—I. M. Lifshits & S. I. Pekar. (*Uspekhi fiz. Nauk*, Aug. 1955, Vol. 56, No. 4, pp. 531–568.) A review. About half of the 68 references are to Russian work.

535.215 **373**

Photo [-electric] **Effect in Metals.**—S. V. Vonsovski, A. V. Sokolov & A. Z. Veksler. (*Uspekhi fiz. Nauk*, Aug. 1955, Vol. 56, No. 4, pp. 477–530.) A critical survey with particular reference to the theoretical development of the subject. 65 references.

535.376 **374**

Electroluminescence excited by Short Field Pulses.—F. Matossi & S. Nudelman. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1100–1103.) An extension of a previous investigation [1307 of 1955 (Nudelman & Matossi)] is reported; pulses of duration 40–2 500 μs were used. The luminescence decay rate is highest for the shortest pulses. Results are consistent with previous conclusions regarding polarization effects [2898 of 1955 (Matossi)]; a threshold pulse duration of about 700 μs is estimated to be necessary for the accumulation of polarization charges.

535.376 **375**

Dependence of Light Amplification in Phosphors on Light Intensity.—F. Matossi. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1332–1333.)

535.623 : 621.397.5 **376**

Differential Chromaticity Thresholds in the Direction of Primary Blue in a Trichromatic-Synthesis System.—Billard. (See 583.)

537.226 **377**

Dielectric Properties of Ice at Very Low Frequencies and the Influence of a Polarizing Field.—H. Gränicher, C. Jaccard, P. Scherrer & A. Steinemann. (*Helv. phys. Acta*, 31st Aug. 1955, Vol. 28, No. 4, pp. 300–303. In German.) Measurements at frequencies down to 0·7 c/s are reported. The loss factor passes through a low-frequency maximum which is distinguishable from that associated with the dipole dispersion by its different temperature dependence. The effect of impurities is to shift the maximum towards higher frequencies. Application of a unidirectional field does not affect the permittivity of the pure crystals but eliminates the low-frequency dispersion when impurities are present. The observations are consistent with MacDonald's theory (1024 of 1954).

537.226.2 **378**

The Dielectric Constant of an Imperfect Non-Polar Gas.—A. D. Buckingham & J. A. Pople. (*Trans. Faraday Soc.*, Aug. 1955, Vol. 51, No. 392, pp. 1029–1035.)

537.311.31 **379**

Electron-Phonon Interaction in Metals.—J. Bardeen & D. Pines. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1140–1150.) "The role of electron-electron interactions in determining the electron-phonon interaction in metals is investigated by extending the Bohm-Pines collective description to take into account the ionic motion."

537.311.31 : 537.312.8 **380**

Single Band Motion of Conduction Electrons in a Uniform Magnetic Field.—P. G. Harper. (*Proc. Phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430A, pp. 874–878.)

537.311.31 : 537.312.8 : 538.113 **381**

The General Motion of Conduction Electrons in a Uniform Magnetic Field, with Application to the Diamagnetism of Metals.—P. G. Harper. (*Proc. Phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430A, pp. 879–892.)

537.311.37 : 537.562 **382**

Theory of the Electrical Conductivity of a Plasma.—H. Schirmer. (*Z. Phys.*, 27th Aug. 1955, Vol. 142, No. 1, pp. 1–13.) The calculation presented is based on integration of the Boltzmann equation in which the atoms, ions and electrons are not treated as rigid, perfectly elastic spherical scattering centres.

537.312.8 **383**

The Importance and the Origin of Modes of Description of Magnetogalvanic Effects.—A. L. Perrier. (*Helv. phys. Acta*, 31st Aug. 1955, Vol. 28, No. 4, pp. 312–316. In French.) See also 2337 of 1955 (Perrier & Ascher).

537.5 **384**

Statistical Description of Assemblies with Collective Interaction: Part 3.—The Various Formulations of the Carrier Kinetics.—G. Ecker. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 294–306.) The range of validity of approximations made in analyses by other workers is discussed. Parts 1 & 2: 2907 of 1955.

537.5 **385**

Pulse-Controlled Cathode Sputtering and Electron Emission.—A. Güntherschulze. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 346–353.)

537.5 **386**

Electron Liberation by Low-Energy Ions at Metal Surfaces and in Gases.—H. Fetz. (*Brit. J. appl. Phys.*, Aug. 1955, Vol. 6, No. 8, pp. 288–291.) Two experimental methods of investigation are described; the disturbing influence of photo-ionization was completely eliminated. Results indicate that in certain cases ionization in the gas by collision of ions may be important.

537.52 **387**

Mechanism of Uniform Field Breakdown in Hydrogen.—A. Wilkes, W. Hopwood & N. J. Peacock. (*Nature, Lond.*, 29th Oct. 1955, Vol. 176, No. 4487, pp. 837–838.)

537.523 **388**

Growth of Current between Parallel Plates.—P. M. Davidson. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1072–1074.) Analysis for the initial stages of a

discharge involving secondary electron emission is presented in an alternative form to that given previously [3262 of 1953 (Dutton et al.; mathematical appendix by Davidson)].

537.525.8 : 535.215 **389**

Reduction of the Cathode Fall [of potential] **of a Normal Glow Discharge by Illumination of the Cathode.**—W. Kluge & A. Schulz. (*Z. Phys.*, 27th Aug. 1955, Vol. 142, No. 1, pp. 83–86.) Experimental results indicate that the relation between the normal cathode fall U_{kn}, the cathode work function Φ_a and the current density due to illumination j_o is given by $U_{kn} = A\,\Phi_a - Bj_o$, where A is a constant whose magnitude depends on the ionization potential of the gas and B is another constant. A special Ag-based cathode with KH and adsorbed K layers was used (585 of 1955).

537.525.8 : 537.212.082.72 **390**

Measurement of Electric Fields as applied to Glow Discharges.—R. W. Warren. (*Rev. sci. Instrum.*, Aug. 1955, Vol. 26, No. 8, pp. 765–770.) A magnetically compensated zero-deflection electron-beam method is described. Using automatic recording, field strengths between 1 000 V/cm and 0·2 V/cm can be rapidly measured and tube-wall potentials can simultaneously be recorded.

537.533 **391**

Electron Emission from Cathode Surfaces after Glow Discharges.—R. Röhler. (*Naturwissenschaften*, Aug. 1955, Vol. 42, No. 16, pp. 459–460.) Brief account of experiments made to elucidate exo-electron-emission phenomena.

537.533 **392**

T-F [temperature and field] **Emission: Experimental Measurement of the Average Electron Current Density from Tungsten.**—W. P. Dyke, J. P. Barbour, E. E. Martin & J. K. Trolan. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1192–1195.) The results of the experiments reported support the theory presented previously [88 of 1955 (Dolan & Dyke)].

537.533 : 530.145 **393**

Quantum Effects in the Interaction between Free Electrons and Electromagnetic Fields.—P. S. Farago & G. Marx. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1063–1064.) A discussion of the possibility of arranging experiments so that the spread of an electron beam in a transverse r.f. field due to the quantum dispersion of the energy exchange can be distinguished from that due to practical experimental factors.

537.533 : 535.31 **394**

Two Problems in Geometrical Optics and Application of the Results in Electron Trajectory Calculations.—S. V. Yadavalli. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1670–1671.)

537.56 **395**

A Semi-empirical Expression for the First Townsend Coefficient of Molecular Gases.—R. W. Crowe, J. K. Bragg & J. C. Devins. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1121–1124.) The formula derived by Druyvesteyn & Penning (*Rev. mod. Phys.*, April 1940, Vol. 12, No. 2, pp. 87–174) is discussed and is modified on the basis of different assumptions regarding the energy dependence of the scattering cross-sections of the gas molecules.

537.56 **396**

Atomic Negative-Ion-Photodetachment Cross-Section and Affinity Measurements.—S. J. Smith & L. M. Branscomb. (*J. Res. nat. Bur. Stand.*, Sept. 1955, Vol. 55, No. 3, pp. 165–176.) "The spectral distributions of the H^- and O^- cross sections for photodetachment have been measured. The H^- measurements are consistent with the theory of Chandrasekhar. A curve has been fitted to the results for O^-. The threshold of this cross section, the affinity of O^-, is found to be $1{\cdot}48 \pm 0{\cdot}10$ electron volts. No evidence is found for resonance at the threshold or for the existence of excited O^- ions. The apparatus is described in detail."

538.114 **397**

Dipolar Ferromagnetism at 0°K.—M. H. Cohen & F. Keffer. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1135–1140.)

538.566 : 517 **398**

Asymptotic Expansions of Solutions of $(\nabla^2 + k^2)u = 0$.—F. G. Friedlander & J. B. Keller. (*Commun. pure appl. Math.*, Aug. 1955, Vol. 8, No. 3, pp. 387–394.) The equation investigated is important in the theory of wave propagation. A direct method is developed for obtaining more general asymptotic expansions than those given previously [646 of 1952 (Kline)].

538.566 : 535.42 **399**

Strict Theory of the Diffraction of Electromagnetic Waves by Plane Screens.—K. Westpfahl. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 354–373.) Analysis is based on the Hertz, or Fitzgerald, vector, which can be represented by a double Fourier integral; the Fourier amplitudes giving the angular distribution of the far field are derived from a system of simultaneous integral equations which can be solved approximately by developing in certain orthogonal systems. An alternative method of solution is an iteration process based on the Kirchhoff approximation. The relation with Huyghens' principle and with the variation problem of diffraction theory is established.

538.566 : 535.42 **400**

Diffraction of Microwaves by Long Metal Cylinders.—A. W. Adey. (*Canad. J. Phys.*, Aug. 1955, Vol. 33, No. 8, pp. 407–419.) Report of an experimental investigation at about 3 cm λ, using parallel-plate equipment based on that described by El-Kharadly (e.g. 1261 of May) and cylindrical obstacles of transverse dimensions comparable with λ. Calculated and experimental results for circular cylinders are in good agreement and are used as a basis for studying diffraction by square and rectangular cylinders. The method gives reliable information about scattering from obstacles of forms such that no exact theoretical solutions are available.

538.566 : 535.43 **401**

On the Scattering Cross Section of an Obstacle.—D. S. Jones. (*Phil. Mag.*, Sept. 1955, Vol. 46, No. 380, pp. 957–962.) The relation between the scattering cross-section and the scattered amplitude for an obstacle in an incident plane wave, previously discussed by van de Hulst (601 of 1950), is here established by a calculation of the energy flow. When the incident wave emanates from a point source, the sum of the scattering and absorption cross-sections is determined by the value of a certain field in the neighbourhood of the source. The discussion is presented in terms of an e.m. wave, but is adaptable to sound waves or atomic collisions.

538.569.4 : 621.372.029.64 **402**

Possible Methods of obtaining Active Molecules for the Molecular Generator.—N. G. Basov & A. M. Prokhorov. (*Zh. eksp. teor. Fiz.*, Feb. 1955, Vol. 28, No. 2, pp. 249–250.) The use is suggested of an auxiliary h.f. field to produce resonance transitions between the energy levels in the molecules such as to increase the fraction of active molecules in the beam. See also 348 above and back references.

538.569.4 : 621.372.029.64 **403**

The Maser—New Type of Microwave Amplifier, Frequency Standard, and Spectrometer.—J. P. Gordon, H. J. Zeiger & C. H. Townes. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1264–1274.) Experimental results with the device described previously (100 of 1955) are compared with predictions from theory. Particular attention is given to operation with ammonia molecules. An amplifier noise figure of unity should be attainable under certain conditions.

539.15.098 : 538.569.4 **404**

Influence of an Inhomogeneity of the High-Frequency Field in Nuclear Magnetic Resonance.—H. Pfeifer. (*Z. angew. Phys.*, Aug. 1955, Vol. 7, No. 8, pp. 389–391.) Theoretical results show that, to a first-order approximation, the inhomogeneity has no effect on the signal amplitude provided that the conditions for a maximal signal in a homogeneous field are fulfilled.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **405**

Radio Stars and their Cosmological Significance.—M. Ryle. (*Observatory*, Aug. 1955, Vol. 75, No. 887, pp. 137–147.) A survey presented as the 1955 Halley lecture. See also 3588 of 1955 (Ryle & Scheuer).

523.16 : 523.4 **406**

Location on Jupiter of a Source of Radio Noise.—C. A. Shain. (*Nature, Lond.*, 29th Oct. 1955, Vol. 176, No. 4487, pp. 836–837.) Earlier records of r.f. radiation and of visually observed activity on Jupiter are discussed in relation to the observation of a r.f. source by Burke & Franklin (2933 of 1955); this r.f. source is probably identifiable with the visibly disturbed region observed by Fox (*J. Brit. astr. Assoc.*, 1952, Vol. 62, p. 280).

523.16 : 523.45 **407**

On the Great Importance of the R.F. Radiation from the Planet Jupiter.—O. Majorana. (*R.C. Accad. naz. Lincei*, July/Aug. 1955, Vol. 19, Nos. 1/2, pp. 17–22.) Continuation of the previous discussion (3591 of 1955) of the observations reported by Burke & Franklin (2933 of 1955). The cyclic variation of relative position of points on Jupiter and on the earth is examined. Based on considerations of temperature and composition, the hypothesis is advanced that the observed radiation is produced by continuous eruption of solid electrified blocks of iron with linear dimensions of the order of $\lambda/4$; such eruptions could be expected in the vicinity of the large red spot on Jupiter. The relevance of the hypothesis to astronautical problems is briefly indicated.

523.16 : 546.11.02 **408**

Monochromatic Radiation of Deuterium at a Wavelength of 91·6 cm from the Centre of the Galaxy.—G. G. Getmantsev, K. S. Stankevich & V. S. Troitski. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1955, Vol. 103, No. 5, pp. 783–786. In Russian.) A brief report is presented of observations indicating the presence of deuterium in the interstellar space; the concentration is about 3×10^{-2} that of the non-ionized hydrogen. A block diagram is given of the equipment used in conjunction with a $\lambda/2$ dipole aerial at the focus of a 4-m-diameter parabolic reflector.

523.5 **409**

Note on the Electrophysical Determination of the Velocities of Meteors.—C. Hoffmeister. (*Naturwissenschaften*, Aug. 1955, Vol. 42, No. 16, p. 458.) The question is briefly discussed whether the trail is electrically reflecting immediately after passage of the meteor or only after the ionized cylinder has expanded to a certain diameter. The answer is decisive for the theory of the origin of the interplanetary material.

523.53 : 621.396.96 **410**

The Giacobinid Meteor Stream.—J. G. Davies & A. C. B. Lovell. (*Mon. Not. R. astr. Soc.*, 1955, Vol. 115, No. 1, pp. 23–31.) An account is given of the systematic radio-echo observations in the years 1947–1954; the unexpected return of the meteor shower during the daytime in 1952 and the significance of its absence in 1953 are discussed.

523.7 : 621.396.822.029.6 **411**

Influence of the Age of [solar] **R.F. Centres on their Radiation at Centimetre Wavelengths.**—B. Vauquois. (*C. R. Acad. Sci., Paris*, 19th Sept. 1955, Vol. 241, No. 12, pp. 739–740.) Continuation of investigation reported previously (2939 of 1955). The r.f. flux from an active centre appears to vary directly as its sunspot area for the first 15 days of its life, after which it decreases more slowly than the sunspot area. The corresponding 'aging function' is shown graphically.

523.72 : 551.510.535 **412**

Brightening of the Solar Limb in the Far Ultra-Violet.—C. M. Minnis. (*Nature, Lond.*, 1st Oct. 1955, Vol. 176, No. 4483, pp. 652–653.) Locations and relative intensities of sources controlling the E and F_1 layers, as provisionally determined from measurements of electron density made at Slough and Inverness during the solar eclipse of 30th June 1954, indicate brightening of the solar limb near the equator and darkening of the limb at the poles. The intensity distribution over the solar disk is similar to that found by Christiansen & Warburton (2606 of 1955) for radiation on 21 cm λ.

550.3 **413**

Electromagnetic Induction in a Two-Layer Earth.—B. K. Bhattacharyya. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 279–288.) The theory developed by Price (1617 of 1951) is extended to determine the induced field on the surface of a medium whose conductivity is a function of depth. The results are applied to evaluate the field induced when an oscillating magnetic dipole is placed on the surface of a flat two-layer earth.

550.380.8 **414**

A Measurement of the Earth's Magnetic Field by Nuclear Induction.—G. S. Waters. (*Nature, Lond.*, 8th Oct. 1955, Vol. 176, No. 4484, p. 691.) The free-precession technique outlined by Packard & Varian (*Phys. Rev.*, 15th Feb. 1954, Vol. 93, No. 4, p. 941) is used.

550.385 **415**

Daytime Enhancement of Size of Sudden Commencements [SC's] **and Initial Phase of Magnetic Storms at Huancayo.**—S. E. Forbush & E. H. Vestine. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 299–316.) Statistical analysis of data for the period 1922–1946 shows that the frequency of occurrence of SC's is independent of the time of day, but that the average size of

SC's and of initial phases of magnetic storms is greater during daylight hours. The size is also found to vary directly with the amplitude of the diurnal variation of H. Both phenomena may be due to electrojets in polar latitudes caused by the sun.

550.385 : 523.78 **416**

Magnetic Effects during Solar Eclipses.—A. M. van Wijk. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 297–298.) Records taken in South Africa at the time of the annular eclipse of the sun on 25th December 1954 show a decrease in intensity of the geomagnetic-field horizontal component, in accordance with theory, but also an increase in the vertical component.

551.510.5 **417**

Observation of an 'Ozone Hole' over the Alps.—H. K. Paetzold & H. Zschörner. (*Z. Met.*, Aug. 1955, Vol. 9, No. 8, pp. 250–251.) Observations are reported which throw light on the relations between vertical air streams in the stratosphere and the vertical distribution of ozone.

551.510.535 **418**

Movements of Irregularities in the E Region.—T. Obayashi. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 59–67; *Rep. Ionosphere Res. Japan*, June 1955, Vol. 9, No. 2, pp. 105–113.) Summer-night observations of fading patterns of transmissions from three broadcasting stations spaced about 150 km apart at the vertices of a triangle are consistent with large-scale movements in the E region, from east to west, with velocities of 50–150 m/s. Rapid fading, with a duration of a few hours, is considered to be due to scattering by E_s clouds showing turbulent velocities of 10–15 m/s.

551.510.535 **419**

World-Wide Daily Variations in the Height of the Maximum Electron Density of the Ionospheric F_2 Layer.—T. Shimazaki. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 85–97.) A formula relating h_pF_2 to (M 3000) F_2 is applied to determine world-wide latitudinal variations of h_pF_2 for 1952, the results so obtained being in good agreement with results published by local observatories. In middle and higher latitudes h_pF_2 rises in summer daytime and falls in winter daytime. Near the equator there is a daytime rise throughout the year.

551.510.535 **420**

A Discussion on the Variation of F-Region Height.—B. Chatterjee. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 325–327.) Further evidence is adduced in support of the author's suggestions regarding the distribution of ionization in the F region (2939 of 1954).

551.510.535 **421**

Contribution to the Study of the Effect of Geomagnetism on the F_1 Layer.—R. Eyfrig. (*C. R. Acad. Sci., Paris*, 19th Sept. 1955, Vol. 241, No. 12, pp. 759–761.) Results of an analysis of observations for 1943, 1944 and 1954 confirm the dip in the value of f_0F_1 at the magnetic equator reported by Ghosh (1983 of 1955). There is also a minimum in the values of the (M 3000)F_1 factor and the m.u.f. at the magnetic equator.

551.510.535 : 523.16 **422**

Radio Star Scintillations and the Ionosphere.—T. R. Hartz. (*Canad. J. Phys.*, Aug. 1955, Vol. 33, No. 8, pp. 476–482.) "The observed intensity at the surface of the earth of radiation at a frequency of 50 Mc/s from a radio star has been studied. A relationship is shown to exist between the fluctuations, or scintillations, in this observed radiation intensity and the angle of its incidence on the 400 km level of the earth's ionosphere. The occurrence of these scintillations is compared with other ionospheric phenomena as determined by vertical soundings from the earth. The probable cause of the fluctuations has been localized to a source in the high ionospheric regions."

551.510.535 + 550.385] : 523.75 **423**

Effect of Radiation from Solar Flares on the Ionosphere and the Earth's Magnetic Field.—R. N. Sedra & I. B. Hazzaa. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1070–1072.) "Variation in the earth's magnetic field and the corresponding variations in the ionic density of the F_1 layer due to solar flares are recorded. The value of the intensity of ultraviolet radiation before it enters the atmosphere is obtained. The constant relating the ionic density and the accompanying magnetic variation is also estimated."

551.510.535 : 550.38 **424**

Geomagnetic Distortion of the F_2 Region on the Magnetic Equator.—M. Hirono & H. Maeda. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 241–255.) See 3257 of 1955.

551.510.535 : 550.38 **425**

Researches on the Geomagnetic Distortion in the Ionosphere.—(*Rep. Ionosphere Res. Japan*, June 1955, Vol. 9, No. 2, pp. 59–104.)

Part 1—Observed Facts of the Geomagnetic Distortion in the Ionosphere.—H. Maeda (pp. 59–70).

Part 2—Theoretical Study on the Geomagnetic Distortion in the F_2 Layer.—K. Maeda (pp. 71–85).

Part 3—Characteristics of the F_2 Layer on the Magnetic Equator.—M. Hirono & H. Maeda (pp. 86–94).

Part 4—Effect of Gravity and Ionization Pressure Gradient on the Vertical Drift in the F_2 Region.—M. Hirono (pp. 95–104).

World-wide observations made during the sun-spot minimum period (1953–1954) and during the second Polar Year (1932–1933) are analysed and discussed theoretically. The anomalous distribution in the F_2 region above the magnetic equator may be explained by vertical electron drifts caused by the electric field. An ionospheric model consistent with the results of rocket experiments is used. The particle density at altitude 300 km must be of the order of 10^{10}/cm^3.

551.510.535 : 550.385 **426**

Studies on the Disturbances in F_2 Layer associated with Geomagnetic Disturbances.—K. Sinno. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 69–76.) Earlier work is summarized and discussed. See also 3258 of 1955.

551.593.5 **427**

Day Sky Brightness to 220 km.—O. E. Berg. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 271–277.) Measurements made with rocket-borne stereocameras suggest that the brightness is due entirely to Rayleigh scattering by air molecules. There is no evidence of high-altitude clouds.

551.594.5 : 621.396.11 **428**

Double-Doppler Radar Investigations of Aurora.—A. G. McNamara. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 257–269.) The power spectra of auroral echoes of signals on 90·7 Mc/s are compared with observations of the visible aurorae and with simultaneous echoes of signals on 56 and 106 Mc/s, using standard high-resolution radar equipment. A number of auroral models are considered in a discussion of the results.

551.594.5 : 621.396.11 **429**

Auroral Echoes observed North of the Auroral Zone on 51·9 Mc/s.—R. B. Dyce. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 317–323.) At a site north of the accepted auroral-zone maximum, radar echoes on a frequency of 51·9 Mc/s were readily obtained from the north, but practically none from the south; the range of the reflecting points was from 500 to 1100 km. These results are in agreement with the theory of reflection by aurorae suggested by Moore (*Trans. Inst. Radio Engrs*, 1952, PGAP-3, pp. 217–230) and developed by Booker et al. (1986 of 1955), requiring near-perpendicularity of radio ray paths to the lines of the earth's magnetic field. On transmitting towards the south, across visible aurorae, on 51·7 Mc/s, propagation associated with aurora was almost nonexistent, as required by the theory.

551.594.6 : 621.396.11 **430**

Measurement of the Arrival Angle of 'Whistlers'.—D. D. Crombie. (*J. geophys. Res.*, Sept. 1955, Vol. 60, No. 3, pp. 364–365.) It is suggested that Storey's theory on the origin of whistling atmospherics (142 of 1954) could be tested by determining their arrival angle by a phase-measurement method based on that of Ross et al. (2804 of 1951), using a pair of aerials spaced 15 km apart along the direction of the horizontal component of the geomagnetic field.

LOCATION AND AIDS TO NAVIGATION

621.396.93 : 621.396.677.3 **431**

Design for Wide-Aperture Direction Finders.—Benoit & Furlow. (See 330.)

621.396.932 **432**

Explanation of Difficulties in Direction-Finding on Ships when using Short or Intermediate Wavelengths.—G. Zichm. (*Frequenz*, Sept., 1955, Vol. 9, No. 9, pp. 310–318.) See 1045 of 1955 (Troost).

621.396.933 **433**

Air Navigational Facilities.—H. S. Christensen. (*Proc. Radio Cl. Amer.*, 1955, Vol. 32, No. 1, pp. 3–8.) An outline of the method and equipment used in the U.S.A. for guiding and directing aircraft during flight, airport approach and landing.

621.396.933 **434**

Radio Navaids.—'Radiophare'. (*Wireless World*, Dec. 1955, Vol. 61, No. 12, pp. 576–577.) A comparison of the Decca and TACAN (125 of January) short-range radio-navigation systems.

621.396.96 : 551.578.1 **435**

Airborne Weather-Surveillance Radar.—(*Elect. J.*, 12th Aug. 1955, Vol. 155, No. 4026, pp. 546–548.) Description of commercially available equipment for installation in the nose of an aircraft. Operating wavelength is 5·6 cm for one type and 3·2 cm for another. The most important advantage for the pilot is the possibility of avoiding the centre of a storm. See also 1048 of 1955.

621.396.96 : 621.317.763.029.64 **436**

A Simplified Form of Microwave Interferometer for Speed Measurements.—Court. (See 533.)

621.396.96 : 621.374.4 : 621.318.435 **437**

Saturable-Reactor Frequency Divider.—Court & Scollay. (See 359.)

621.396.96 : 621.396.11 **438**

Determination of the Reflection Coefficient of the Sea, for Radar-Coverage Calculation, by an Optical Analogy Method.—G. W. G. Court. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 827–830.) The problem of the reflection of radio waves from a rough sea surface is considered by analogy with the reflection of light waves from a ground-glass surface. A typical radar vertical-coverage diagram derived by this method shows the effect of the variation of sea-surface conditions.

621.396.96 : 621.396.62 **439**

On the Problem of Optimum Detection of Pulsed Signals in Noise.—A. H. Benner & R. F. Drenick. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 461–479.) "A detection philosophy is introduced which distinguishes only the presence or absence of a pulsed signal, avoiding the designation of signal location. This so-called interval detector is formulated statistically as a composite hypothesis problem and solved by decision function theory. The optimum decision rule is derived, its superiority in principle to others is proven, and an illustrative mechanization is described. The explicit evaluation of this optimum relative to other detection procedures has been achieved only in special border cases, one of which is included as an example."

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **440**

Oscillographic Measurement of the Penning-Gauge Characteristics.—M. Varićak. (*J. sci. Instrum.*, Sept. 1955, Vol. 32, No. 9, pp. 346–348.) Optimum working conditions for the Penning vacuum gauge are readily attained by adjusting in accordance with an oscilloscope display of curves showing the variation of discharge current with magnetic field strength in the gauge.

535.215 : 537.311.33 **441**

Infrared Quenching and a Unified Description of Photoconductivity Phenomena in Cadmium Sulfide and Selenide.—R. H. Bube. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1105–1116.) An apparent paradox in the results presented by Rose (2002 of 1955) is discussed. A theoretical and experimental investigation shows that infrared quenching, 'superlinear' photocurrent, and the particular temperature dependence of photocurrent in CdS and CdSe may all be associated with the filling and emptying of a specific set of defect levels, as indicated by the location of the calculated Fermi level. Values are determined for the energy levels involved.

535.37 : 546.472.21 **442**

Determination of Effective Cross-Sections of Capture and Recombination of Thermal Electrons in ZnS-Cu,Co Phosphors.—Syui Syui-Yun. (*C. R. Acad. Sci. U.R.S.S.*, 1st Aug. 1955, Vol. 103, No. 4, pp. 585–588. In Russian.)

535.37 : 546.472.21 **443**

Effects of Infrared on Emission of ZnS:Cu Phosphors.—K. Nakamura. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 715–716.) Hex-ZnS:Cu phosphors containing 0·069% Ag, 2·5% NaCl and between 0 and 0·3% Cu, excited at various temperatures between $-25°$ and $+25°$C by ultraviolet radiation, show a spectral shift towards green under infrared illumination and towards blue under red light. These results are not consistent with Bube's conclusions (648 of 1951).

535.37 : 621.385.832 **444**

Transparent Phosphor Coatings.—F. J. Studer & D. A. Cusano. (*J. opt. Soc. Amer.*, July 1955, Vol. 45, No. 7, pp. 493–497.) Coatings of various materials have been deposited on glass surfaces by chemical reaction of

the components in the vapour state. The most satisfactory material is ZnS, activated with As, Cu, Mn, P or Zn. Under cathode-ray excitation brightness values as high as 400 foot-lamberts are obtained at 20 kV and 1 $\mu A/cm^2$. Under ultraviolet excitation the response is low.

535.376 **445**

Reversible Impairment of Phosphors by Positive Ions.—W. Berthold. (*Naturwissenschaften*, Aug. 1955, Vol. 42, No. 15, pp. 436–437.) The decrease of luminescence of a ZnS-Ag phosphor bombarded by H_2^+ ions and its recovery on subsequent excitation by electrons were studied using specially gettered tubes with the screen deposited on a transparent conducting layer to facilitate photoelectric measurements. Under ionic bombardment the decrease of luminescence was first exponential and later in accordance with the expression $I/(1 + cNt)$, where N is the number of bombarding ions per sec and c is a parameter indicating the degree of impairment, its value depending on the energy of the bombarding ions. The recovery effect on subsequent electron bombardment varies inversely with the energy of the bombarding ions. The results indicate that part of the damage caused by the ions is permanent.

535.376 **446**

Influence of Alternating Electric Fields on the Light Emission of some Phosphors.—I. T. Steinberger, W. Low & E. Alexander. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1217–1222.) Experiments were made with various ZnS and ZnS:CdS phosphors. The brightness wave-form during fluorescence consists of two different pulses per cycle; the pulses corresponding to positive polarity are similar for all phosphors, those corresponding to negative polarity differ. Mechanisms affording possible explanations of the observations are discussed.

537.22 : 549.514.5 **447**

Adhesion and Charging of Quartz Surfaces.—W. R. Harper. (*Proc. roy. Soc. A.*, 6th Sept. 1955, Vol. 231, No. 1186, pp. 388–403.) Experiments are reported which indicate that the charging of quartz surfaces by each other results from different orientation with respect to the crystal axes.

537.226 **448**

Conditions for Forming and Stability of [interface] **Layers near Electrodes in Dielectrics.**—Ya. N. Pershits. (*Zh. eksp. teor. Fiz.*, Feb. 1955, Vol. 28, No. 2, pp. 181–190.) An experimental investigation is reported on layers with unidirectional conductivity formed at the electrode/dielectric interface, and of the effects on the properties of these layers of various heat pretreatments and electric fields. The dielectrics included porcelain, eternit, mica and asbestos; quartz and alkali halides were investigated earlier (*ibid.*, 1947, Vol. 17, p. 251).

537.226/.227 : 546.48.882.5 **449**

Specific Heat Anomaly of Ferroelectric Cadmium Niobate at the Curie Temperature.—H. R. Danner & R. Pepinsky. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1215–1217.)

537.226.2 : 621.317.335.029.63 **450**

Decimetre-Wavelength Measurements of the Dielectric Behaviour of Various Clays as a Function of their Water Content.—E. Deeg & O. Huber. (*Naturwissenschaften*, Sept. 1955, Vol. 42, No. 18, p. 507.)

537.226.31 : 549.514.51 **451**

Dielectric Losses of Various Monocrystals of Quartz at Very Low Temperatures.—J. Volger, J. M. Stevels & C. van Amerongen. (*Philips Res. Rep.*, Aug. 1955, Vol. 10, No. 4, pp. 260–280.) Measurements were made on (*a*) clear, (*b*) irradiated, and (*c*) naturally smoky quartz and on (*d*) amethyst, at frequencies of 1 and 32 kc/s. Maxima exhibited by the dielectric-loss/temperature curve at temperatures between 14° and 150°K are related to lattice defects.

537.227 : 546.431.824-31 **452**

Optical Observations of the First-Order Transition of Barium Titanate Single Crystal at the Curie Point.—A. Nishioka. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 535–540.)

537.227 : 546.431.824-31 **453**

Thermal Transition of Transparency in Ferroelectric Single Crystal of Barium Titanate.—T. Horie, K. Kawabe, M. Tachiki & S. Sawada. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 541–549.)

537.227 : 546.431.824-31 **454**

Electrical Behaviour of Barium Titanate Single Crystals at Low Temperatures.—H. H. Wieder. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1161–1165.) Measurements were made over a temperature range including the phase transitions from tetragonal to orthorhombic at − 5°C and from orthorhombic to rhombohedral at − 92°C. As the temperature decreases through a transition, the coercivity, polarization-reversal time and spontaneous polarization decrease discontinuously. Dielectric constant varies linearly with switching time; this supports the theory of a relaxation mechanism for polarization reversal.

537.228.1 : 538.569.4 **455**

Radio-Frequency Absorption Spectra of [lattice] **Vibrations of some Piezoelectric Solids.**—J. Duchesne & A. Monfils. (*C. R. Acad. Sci., Paris*, 19th Sept. 1955, Vol. 241, No. 12, pp. 749–750.) Data for Rochelle salt, quartz and some organic substances of importance in biology are presented and discussed.

537.311.31 **456**

Resistance of Metals at High Current Densities.—V. V. Bondarenko, I. F. Kvartskhava, A. A. Plyutto & A. A. Chernov. (*Zh. eksp. teor. Fiz.*, Feb. 1955, Vol. 28, No. 2, pp. 191–198.) Results of an experimental investigation indicate that Ohm's Law is obeyed with an error of less than ±7% at current densities up to 10^7 A/cm^2 in Cu, Ag, Pt, Al, W and Fe at temperatures from a few tens of degrees C up to and beyond the melting point.

537.311.31+537.311.33] : 539.16 **457**

A Survey of Irradiation Effects in Metals.—J. W. Glen. (*Advances Phys.*, Oct. 1955, Vol. 4, No. 16, pp. 381–478.) Attention is confined to those changes which seem to be caused by disrupting the lattice of a solid without changing the nature of the molecules of which it is composed; the properties discussed include electrical conductivity, diffusion and thermoelectricity. A brief survey of the effects of radiation on semiconductors is also included. Over 200 references.

537.311.33 **458**

Theory of Equations of Transport in Strong Electric Fields.—I. M. Tsidil'kovski & F. G. Bass. (*Zh. eksp. teor. Fiz.*, Feb. 1955, Vol. 28, No. 2, p. 245.) Brief critical comment on 3519 of 1954 (Avak'yants). (Note: The original author's name was previously given erroneously as Abak'yants.)

537.311.33 **459**

To intensify the Study of Semiconductor Electronics.—A. Ioffe. (*Radio, Moscow*, Aug. 1955, No. 8, pp. 4–7.) Includes short summaries of papers on semiconductor physics read at the April 1955 meeting of the physico-mathematical section of the U.S.S.R. Academy of Sciences.

537.311.33 **460**

Graphical Treatment of Degeneracy in an Intrinsic Semiconductor.—G. Busch. (*Helv. phys. Acta*, 31st Aug. 1955, Vol. 28, No. 4, pp. 320–321. In German.) See also 1453 of 1954 (Mooser).

537.311.33 **461**

Recombination of Injected Carriers at Dislocation Edges in Semiconductors.—J. P. McKelvey & R. L. Longini. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1227–1232.) "The boundary conditions for carrier recombination at a lineage boundary in a semiconductor in the presence of a constant electric field are derived from kinetic considerations. A non-recombination probability, or 'transmission coefficient' T for a single charge carrier is assumed initially, and 'recombination velocities' at the lineage boundary are expressed in terms of this quantity. A simple experiment to determine the transmission coefficient is suggested. The relationship between the transmission coefficient and the cross section for recombination is investigated, . . ."

537.311.33 : 538.2 **462**

Relation of Magnetic Structure to Electrical Conductivity in NiO and Related Compounds.—R. R. Heikes. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1232–1234.) "A qualitative theory is presented in an effort to understand the insulating properties of NiO. If one generalizes this theory to include all stoichiometric binary compounds, having a transition element as cation and an element from group V or VI as anion, a rather startling correlation between the magnetic and electric properties is predicted. Ferromagnetic compounds should be good conductors with a positive temperature coefficient of resistivity while antiferromagnets should be insulators with a negative temperature coefficient of resistivity. The available data indicate that this correlation does exist."

537.311.33 : 546.26-1 **463**

Preliminary Study of the Electrical Properties of a Semiconducting Diamond.—J. J. Brophy. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1336–1337.)

537.311.33 : [546.28 + 546.289 **464**

Hot Electron Problem in Semiconductors with Spheroidal Energy Surfaces.—M. Shibuya. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1189–1191.) The 'hot-electron' problem, so named by Shockley (1011 of 1952), deals with departures from Ohm's law in semiconductors in strong electric fields. Discrepancies between experimental and theoretical results for Si and Ge are reduced by taking account of ellipsoidal energy surfaces in the Brillouin zone and of scattering by shear modes of vibration.

537.311.33 : [546.28 + 546.289 **465**

Intrinsic Optical Absorption in Single-Crystal Germanium and Silicon at 77°K and 300°K.—W. C. Dash & R. Newman. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1151–1155.) Absorption is assumed to take place by direct and indirect transitions; values of the energy thresholds corresponding to these transitions are estimated from the absorption spectra.

537.311.33 : 546.289 **466**

Dislocations in Germanium.—S. G. Ellis. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1140–1146.) A microscope study of etched Ge crystals is reported, with photographic illustrations. Crystal dislocations forming networks are general; screw dislocation with large Burgers vectors are observed in some cases.

537.311.33 : 546.289 **467**

Rate-Grown Germanium Crystals for High-Frequency Transistors.—H. E. Bridgers & E. D. Kolb. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1188–1189.) The production of n-p-n crystals for experimental tetrode transistors oscillating at frequencies > 1 kMc/s is described. Boron, with a segregation coefficient > 1, is used as an acceptor impurity.

537.311.33 : 546.289 **468**

Fast Neutron Bombardment of *p*-Type Germanium.—J. W. Cleland, J. H. Crawford, Jr, & J. C. Pigg. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1170–1181.) An extensive experimental investigation has been made. Analysis of the observed conduction indicates that the bombardment introduces three vacant states below the middle of the forbidden band. Changes observed after prolonged bombardment or room-temperature aging are discussed. Some bombardments were performed at temperatures from −165° to −90°C; complex relaxation effects were observed on warming. See also 3647 of 1955.

537.311.33 : 546.289 **469**

Properties of Grain Boundaries in Gold-Doped Germanium.—A. G. Tweet. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1182–1189.) Measurements were made of the variation of Hall effect with temperature in high-resistivity specimens of Au-doped Ge containing grain boundaries of known orientation; a new permanent-magnet apparatus used for the measurements is described. The results indicate the existence of a path of relatively low resistivity along the grain boundary, such as would be produced by an array of acceptor levels. A tentative explanation of the observed phenomena is based on Bardeen's theory of surface states (3086 of 1947). See also *ibid.*, pp. 1245–1248.

537.311.33 : 546.289 **470**

Hall Effect and Density of States in Germanium.—E. M. Conwell. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1195–1198.) An analysis is made of corrections required in calculations of activation energy of impurities, and of density of states, to take account of known complexities in the energy-band structure.

537.311.33 : 546.289 **471**

Avalanche Breakdown in Germanium.—S. L. Miller. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1234–1241.) Results of experiments support theory presented by Wolff (746 of 1955).

537.311.33 : 546.289 **472**

Magnetic Indications of Electronic Structure of the Conduction Band in Ge.—J. H. Crawford, Jr, H. C. Schweinler & D. K. Stevens. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1330–1331.) Data on the magnetic susceptibility of the charge carriers afford a means of deciding whether the energy surfaces in the conduction band of Ge are best represented by four or eight ellipsoids.

537.311.33 : 546.289 **473**

Methods for revealing *P-N* Junctions and Inhomogeneities in Germanium Crystals.—J. I. Pankove. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 398–402.) Various methods are described involving etching during immersion in an electrolyte.

537.311.33 : 546.289 : 536.21 **474**

Thermal Conductivity of Germanium at Ambient Temperatures.—K. A. McCarthy & S. S. Ballard. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, p. 1104.) Measurements over the temperature range 5°–95°C are reported; the thermal conductivity varies approximately linearly over this range.

537.311.33 : 546.289 : 539.3 **475**

The Determination of the Elastic Constants of Germanium by Diffuse X-Ray Reflexion.—S. C. Prasad & W. A. Wooster. (*Acta cryst., Camb.*, 10th Aug. 1955, Vol. 8, Part 8, pp. 506–507.)

537.311.33 : 546.289 : 621.383.5 **476**

Influence of Diffusion Length and Surface Recombination on the Barrier-Layer Photoelectric Effect in Germanium.—Harten & Schultz. (See 614.)

537.311.33 : 546.682.86 : 538.63 **477**

On the Galvanomagnetic Effects in *n*-type Indium Antimonide.—Y. Kanai. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 718–719.) Because of the high charge-carrier mobility μ of InSb, usual theory valid for $\mu H \ll 10^8$ is expected not to apply above a certain value of field strength H. The Hall coefficient and the magnetoresistance effect were investigated at field strengths up to 9 kG, at temperatures of the order of −150°C. The Hall coefficient was constant and independent of field strength; the magnetoresistance variations were inconsistent with the usual theory. The results are consistent with quantization of the electron orbit.

537.311.33 : 546.811-17 **478**

Manganese Impurity Centres in Grey Tin.—G. Busch & K. A. Müller. (*Helv. phys. Acta*, 31st Aug. 1955, Vol. 28, No. 4, pp. 319–320. In German.) Measurements of Hall effect in several samples at temperatures between 90° and 260°K give results consistent with the conclusion reached previously by Busch & Mooser (1476 of 1954) that the Mn is incorporated in lattice sites in α-Sn. The solubility of Mn in grey tin is considerably greater than in Ge.

537.311.33 + 535.215] : 546.863.221 **479**

Photoconductivity of Stibnite (Sb_2S_3).—S. Ibuki & S. Yoshimatsu. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 549–554.) Experimental results indicate that stibnite is an *n*-type semiconductor. The peak spectral sensitivity at room temperature occurs at a wavelength of 770 mμ, the thermal activation energy determined from the temperature variation of the dark current between room temperature and 200°C is 0·48 eV, and the response time-lag is about 3 ms for variations of photocurrent around a steady value of 10 μA. The results are presented graphically.

537.311.33 : 621.396.822 **480**

Phenomenological Approach to 'Current Noise'.—D. A. Bell. (*Brit. J. appl. Phys.*, Aug. 1955, Vol. 6, No. 8, pp. 284–287.) Available experimental data on current noise in semiconductors are reviewed. The noise is associated with bulk conductivity rather than with contact phenomena. The inverse-frequency spectrum could be due either to a complicated diffusion process or, more probably, to the law relating mean-square perturbation and time for the whole population of carriers which is not to be regarded as an equilibrium system.

538.221 **481**

On an Empirical Formula for the Ferromagnetic Anisotropy Constant in Cubic Crystals.—M. Yamamoto. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 725–726.) Values derived from a formula presented previously (1077 of 1955) are compared with values found experimentally for Ni-Co and Ni-Cu alloys.

538.221 **482**

Effect of Nitrides on the Coercive Force of Iron.—J. Kerr & C. Wert. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1147–1151.) Measurements indicate that the effect of including flat particles of nitride is most marked for particles whose largest dimensions are comparable with domain-wall thickness.

538.221 **483**

On the Loss of Texture in Tapes of a 50 Pct Ni-50 Pct Fe Alloy.—S. Spachner & W. Rostoker. (*J. Metals, N.Y.*, Aug. 1955, Vol. 7, No. 8, pp. 921–922.) Comparison of the crystal structures of annealed tapes of thickness 2, 1, ½, ¼ and ⅛ mil indicates loss of the characteristic texture associated with a square hysteresis loop at thicknesses < 1 mil. No explanation of the effect is yet established.

538.221 **484**

The Smallest Size of Weiss-Heisenberg Domains in Cobalt.—A. Knappwost. (*Naturwissenschaften*, Aug. 1955, Vol. 42, No. 16, p. 459.) A brief discussion indicates a volume equivalent to a cube of side about 16 Å as the smallest volume for spontaneously magnetized domains in Co. A full account is to be published in *Z. phys. Chem.*

538.221 **485**

Theory of Néel's Spikes and of the Coercive Force associated with the Development of Tubular Secondary Domains ('Schlauchziehen').—R. Brenner. (*Z. angew. Phys.*, Aug. 1955, Vol. 7, No. 8, pp. 391–397.)

538.221 : 538.569.4.029.6 **486**

Frequency Dependence of Magnetic Resonance in α-Fe_2O_3.—H. Kumagai, H. Abe, K. Ono, I. Hayashi, J. Shimada & K. Iwanaga. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1116–1118.) Measurements in the wavelength range 5·4 mm–6·2 cm are reported.

538.221 : 538.632 **487**

Hall Effect in Permalloys.—S. Foner. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1079–1081.) Results of measurements on two different permalloys are compared with results on other alloys and are discussed in relation to the band structure of the materials.

538.221 : 546.73.241 **488**

Magnetic Properties of Cobalt Telluride.—E. Uchida. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 517–522.) Experimental results presented indicate that the magnetic properties of this compound are closely similar to those of MnAs. The saturation magnetization is 7·52 G/g.

538.221 : 621.318.134 **489**

Magnetic Ferrites with Perminvar-Type [hysteresis] **Loops.**—M. Kornetzki, J. Brackmann & J. Frey. (*Naturwissenschaften*, Sept. 1955, Vol. 42, No. 17, p. 482.) Ni and Ni-Zn ferrites with small additions of MnO and

CoO exhibit the hysteresis-loop constriction characteristic of perminvar. If these ferrites are cooled slowly in a magnetic field, a rectangular hysteresis loop is obtained. A full account of the work is to be published in *Siemens-Z.*

538.221 : 621.318.134 **490**

The Behaviour of Ferrite Cores with Rectangular Magnetization Loop in a Nonuniform Magnetic Field or when provided with Gaps.—M. Kornetzki & H. Burger. (*Frequenz*, Sept. 1955, Vol. 9, No. 9, pp. 306–309.) Measurements are reported on MgMn-ferrite toroidal cores with (*a*) relatively small internal diameters, (*b*) nonuniform cross-sections, or (*c*) gaps. Where only a high remanence value is important, slight nonuniformities thus introduced are tolerable; highly rectangular loops can only be obtained with thin, continuous cores, but some nonuniformity of cross-section is tolerable. The results indicate that the rectangular loop in ferrites is a consequence of numerous individual magnetization reversals occurring within a narrow range of magnetic-field values.

538.221 : 621.318.134 **491**

Ferromagnetic Resonance in Magnesium-Manganese Aluminum Ferrite between 160 and 1 900 M/cs.—H. Suhl, L. G. Van Uitert & J. L. Davis. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1180–1182.) Measurements are reported on a disk specimen of stated composition magnetized normal to its plane. Graphs show the variation of resonance frequency with applied field, and the variation of μ'' with applied field at 310 and at 843·64 Mc/s.

538.221 : 621.318.134 : 538.569.4 **492**

Ferromagnetic Resonance in Two Nickel-Iron Ferrites.—W. A. Yager, J. K. Galt & F. R. Merritt. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1203–1210.) Further observations of (*a*) the variation of resonance field-strength with crystal orientation, and (*b*) the variation of the width of the resonance line as a function of temperature, support the conclusions reached previously [2446 of 1954 (Galt et al.)] regarding the mechanism producing losses in ferrites.

538.221 : 621.318.134 : 538.6 **493**

Peculiarities of the Faraday Effect in Paraffin-Ferrite Mixtures.—V. A. Fabrikov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1955, Vol. 103, No. 5, pp. 807–809. In Russian.) The Faraday effect was investigated at frequencies between 2·2 and 3 kMc/s at magnetic field strengths up to 1 500 oersted, using disks of paraffin-ferrite mixture with a typical composition 70% paraffin, 16% Ni-Zn ferrite and 14% rutile, added to increase the dielectric constant. The rotation of the plane of polarization was in a sense opposite to that observed in ferrite disks. The rotation was found to depend on the dimensions of the disks, the field strength, the frequency and the concentration of the ferrites in the mixture. The results are discussed on the basis of theories of the permeability tensor of ferromagnetics.

538.221 : 621.318.134 : 538.652 **494**

Magnetostriction and Permeability of Magnetite and Cobalt-Substituted Magnetite.—L. R. Bickford, Jr, J. Pappis & J. L. Stull. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1210–1214.) Measurements are reported for ferrites of various compositions at temperatures from 120° to 300°K. The substitution of small amounts of Co for divalent Fe produces an upward shift in the temperature at which maximum initial permeability occurs; this maximum is always associated with a change in the direction of easy magnetization.

538.221 : 621.318.134 : 621.372.413 **495**

Measurement of Susceptibility Tensor in Ferrites.—J. O. Artman & P. E. Tannenwald. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1124–1132.) Detailed description of technique outlined previously (769 of 1954) in which a determination is made of the perturbation produced in cavity resonators by introducing ferrite specimens. Measurements on ferramic 1331 at 9·165 kMc/s are reported. Experimental results are discussed in relation to magnetic resonance theory.

538.221 : 621.395.625.3 **496**

Remanence Curve of Single-Domain Ferromagnetic Particles: Application to the Coatings of Sound-Recording Tapes.—E. P. Wohlfarth. (*Research, Lond.*, Aug. 1955, Vol. 8, No. 8, Supplement, pp. S42–S44.) An investigation is made of the dependence on applied field strength of the remanent magnetization of an assembly of randomly oriented particles with uniaxal anisotropy. There is some evidence that the characteristic curve of acicular particles is more suitable than that of nonacicular particles for purposes of magnetic recording.

538.221 : 681.142 **497**

Ferromagnetic Computer Cores.—C. F. Devenny, Jr, & L. G. Thompson. (*Tele-Tech & Electronic Ind.*, Sept. 1955, Vol. 14, No. 9, pp. 58–59 . . 94.) Recent improvements in the properties of rectangular-hysteresis-loop cores are illustrated by characteristic curves relating to 4–79 permalloy and 48% Ni-Fe alloy tape cores.

538.23 **498**

Reversible and Irreversible Magnetization Changes along the Hysteresis Loop.—M. Kersten. (*Z. angew. Phys.*, Aug. 1955, Vol. 7, No. 8, pp. 397–407.) The review presented refers mainly to the physics of the quasistatic hysteresis loop. 37 references include seven to other recent reviews.

538.23 **499**

Theory of Hysteresis Losses in the Rotating Magnetic Field.—M. Kornetzki & I. Lucas. (*Z. Phys.*, 27th Aug. 1955, Vol. 142, No. 1, pp. 70–82.) Experimental evidence indicates that hysteresis losses in a weak rotating field are greater, while those in a strong rotating field are smaller, than in an alternating field of the same strength. This is explained on the basis of Bloch-wall movements at low field strength; these walls disappear at high field strength.

546.87 : 538.632 **500**

Dependence of Hall Effect in Bismuth on Pressure.—L. F. Vereshchagin & A. I. Likhter. (*C. R. Acad. Sci. U.R.S.S.*, 11th Aug. 1955, Vol. 103, No. 5, pp. 791–794.) Measurements are reported at pressures up to 10 000 kg/cm² in magnetic fields up to 10 000 oersted; the Hall e.m.f. decreases with increasing pressure.

621.315.612 **501**

Materials used in Radio and Electronic Engineering. Ceramics. (*J. Brit. Instn Radio Engrs*, Oct. 1955, Vol. 15, No. 10, pp. 506–517.) A survey including tables of properties of various classes of ceramics and 111 references.

621.315.612.6 : 538.569.4 **502**

Paramagnetic Resonance Absorption in Glass.—R. H. Sands. (*Phys. Rev.*, 15th Aug. 1955, Vol. 99, No. 4, pp. 1222–1226.)

621.372.412.002.2 : 549.514.51 **503**

Vacuum-Plating Equipment for the Manufacture of Quartz Resonators.—H. Awender, E. Becker & K. Sann. (*Telefunken Ztg.*, March 1955, Vol. 28, No. 107, pp. 34–38. English summary, pp. 60–61.) Three receptacles on a turntable are (*a*) charged with crystal and evaporation metal, (*b*) roughly evacuated, (*c*) connected to oil diffusion pumps. Beneath each receptacle is an oscillatory circuit. When the nominal frequency of the crystal is attained the evaporation is interrupted by a magnetically actuated shutter. The frequency range covered is 50 kc/s–70 Mc/s.

537.311.33 **504**

Elektronische Halbleiter. [Book Review]—E. Spenke. Publishers: Springer, Berlin, 1955, 379 pp., D.M.34.50. (*Naturwissenschaften*, Aug. 1955, Vol. 42, No. 15, p. 448.) An authoritative introduction to the physical bases of dry rectifiers and transistors.

MATHEMATICS

51 **505**

On Perturbation Methods involving Expansions in Terms of a Parameter.—R. Bellman. (*Quart. appl. Math.*, July 1955, Vol. 13, No. 2, pp. 195–200.) The effectiveness of the method of expanding a solution of an equation in a power series in terms of a parameter may in many cases be greatly increased by expanding in terms of a suitably chosen function of the parameter; this is particularly the case when only positive values of the parameter enter. Examples treated to illustrate the method include van der Pol's equation.

512 **506**

Solution of Quartic Equations.—E. Astuni. (*Ricerca sci.*, Aug. 1955, Vol. 25, No. 8, pp. 2295–2312.) A method is described similar to that used for solving cubic equations (194 of January).

517 **507**

Confluent Hypergeometric Functions.—F. G. Tricomi. (*Z. angew. Math. Phys.*, 25th July 1955, Vol. 6, No. 4, pp. 257–274.) Discussion of a class of functions by means of which second-order linear differential equations can be integrated in closed form.

517 : 538.566 **508**

Asymptotic Expansion of Solutions of $(\nabla^2 + k^2)u = 0$.—Friedlander & Keller. (See 398.)

517 : 621.396.822 **509**

On Middleton's Paper "Some General Results in the Theory of Noise Through Nonlinear Devices".—J. S. Shipman. (*Quart. appl. Math.*, July 1955, Vol. 13, No. 2, pp. 200–201.) The hypergeometric functions in Middleton's formulae (3238 of 1948) can in some cases be reduced to polynomials or combinations of complete elliptic integrals which are special cases of 'Bennett functions' tabulated by Sternberg et al. (1779 of June).

518.3 **510**

Three-Dimensional Nomograms.—D. P. Adams. (*Product Engng.*, Aug. 1955, Vol. 26, No. 8, pp. 186–191.)

517 **511**

Mathieusche Funktionen und Sphäroidfunktionen. [Book Review]—J. Meixner & F. W. Schäfke. Publishers: Springer, Berlin, 1954, 414 pp., D.M. 52.60. (*Z. angew. Phys.*, Aug. 1955, Vol. 7, No. 8, p. 408.)

517(083.5) **512**

Tables des Fonctions de Legendre Associées, Calculées pour le Centre National d'Études des Télécommunications. [Book Review]—Publishers: Édition de la Revue d'Optique, Paris, 1952, 291 pp. (*Z. angew. math. Phys.*, 25th July 1955, Vol. 6, No. 4, p. 344.) The tables presented are useful for the numerical solution of potential problems in spherical co-ordinates.

MEASUREMENTS AND TEST GEAR

531.761 + 529.7 **513**

Definition of the Second of Time.—H. S. Jones. (*Nature, Lond.*, 8th Oct. 1955, Vol. 176, No. 4484, pp. 669–670.) The relations between the value of the second as defined by the International Astronomical Union [200 of January (Essen)], the value corresponding to the Universal time system and that corresponding to the Cs standard [3686 of 1955 (Essen et al.)] are discussed. When the relation between the mean solar second at the present time and the second as newly defined has been satisfactorily determined it will be possible immediately to relate the mean solar second to the fundamental unit of time by means of the Cs standard.

621.3.018.41(083.74) + 621.396.91 **514**

Standard Frequency Transmissions.—L. Essen. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 825–826.) Discussion on 3289 of 1954.

621.3.018.41(083.74) **515**

Standard Frequency Transmission Equipment at Rugby Radio Station.—H. B. Law. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 825–826.) Discussion on 1724 of 1955.

621.3.018.41(083.74) : 621.317.761 **516**

The Standard Frequency Monitor at the National Physical Laboratory.—J. McA. Steele. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 825–826.) Discussion on 1725 of 1955.

621.317.3 : 621.3.018.75(083.74) **517**

IRE Standards on Pulses: Methods of Measurement of Pulse Quantities, 1955.—(*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1610–1616.) Standard 55 I.R.E. 15.S1.

621.317.32.024 **518**

A Superconducting Modulator.—I. M. Templeton. (*J. sci. Instrum.*, Aug. 1955, Vol. 32, No. 8, pp. 314–315.) "A new type of d.c. amplifier for use at liquid helium temperatures, based on a magnetically modulated tantalum wire, is described. The input impedance is approximately $10^{-3}\Omega$, and noise figures down to approximately 2×10^{-11} V are fairly easily obtained. The application of this instrument as a null detector for the measurement of very small voltages in a liquid helium bath is described."

621.317.328.029.64 **519**

A New Perturbation Method for measuring Microwave Fields in Free Space.—A. L. Cullen & J. C. Parr. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 836–844.) "A short thin metal rod forms the perturbing element. In order to avoid confusing the reflection from this rod with unwanted reflection the rod is arranged to spin about an axis perpendicular to its length. The perturbation of the field at the source is therefore modulated at a characteristic frequency, and by using an a.c. amplifier, steady reflections can be eliminated. The apparatus described operates at a wavelength of about 3·2 cm. Experimental results are

given which verify the theory for linearly polarized waves. Extension of the method to elliptically polarized waves is possible in principle, but inherent ambiguities may be troublesome in practice."

621.317.33 : 541.133 **520**

Measurement of Electrical Resistance of Water and Solutions.—A. G. Mamikonov. (*Bull. Acad. Sci. U.R.S.S., sér. tech. Sci.*, March 1955, No. 3, pp. 154–159. In Russian.) Results are reported of l.f. measurements on 0·1 N–1·0 N solutions of NaCl, $CuSO_4$, Na_2SO_4 and KCl, and on sea water. The effective capacitance with sea water was independent of the distance between the electrodes and of the presence of sand, but did vary with the concentrations of the solutions.

621.317.331 : 621.315.612.6 **521**

A Simple D.C. Method for the Determination of the Electrical Resistance of Glass.—H. E. Taylor. (*J. Soc. Glass Tech.*, Aug. 1955, Vol. 39, No. 189, pp. 193T–204T.) A method suitable at the low current densities obtained at room temperature is based on use of a *p*H meter. Resistivities from 10^8 to $10^{13}\,\Omega$.cm are measurable.

621.317.337 **522**

A *Q* Meter Method of measuring Very Low Reactance at High Frequencies.—J. P. Newsome. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 494–498.) A method due to Lafferty (*Electronics*, Nov. 1951, Vol. 24, p. 126) is developed. Details are given of a circuit designed to measure the reactance of inductances as low as 0·003 μH at 1 Mc/s.

621.317.337 : 621.372.412 **523**

A New Method of determining the Quality Factor '*Q*' of Piezoelectric Crystals.—H. Mayer. (*Onde élect.*, July 1955, Vol. 35, No. 340, pp. 692–699.) A fuller account of work described previously (2058 of 1955).

621.317.361 **524**

Designing a Precision Frequency-Measuring System.—A. S. Bagley & D. Hartke. (*Tele-Tech & Electronic Ind.*, Aug. 1955, Vol. 14, No. 8, pp. 84–85 ..142.) By combining a transfer oscillator and frequency converter with a standard high-speed frequency counter the range from zero frequency to 12·4 kMc/s is covered with an accuracy within 1 part in 10^6.

621.317.382.029.64 **525**

The Measurement of Power at a Wavelength of 3 cm by Thermistors and Bolometers.—J. A. Lane. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 819–824.) "A description is given of measurements made on several thermistors and bolometers at wavelengths of 3·18 and 3·26 cm, using a water calorimeter to investigate their performance as indicators of absolute power. The calorimeter, details of which are given, was designed to measure powers of 2–5 watts; and by means of a 35 dB directional coupler known absolute powers at the milliwatt level were delivered to the thermistor and bolometer mounts. Values of efficiency, defined as the ratio of the power measured in a d.c. calibration to the net input power, of 0·87 to 0·91 were found, with no significant change on varying the operating resistance of the thermistors and bolometers over the range 150–300 ohms."

621.317.7 : 621.314.7 **526**

Simplified Transistor Test Equipment.—A. D. Bentley, S. K. Ghandi & V. P. Mathis. (*Tele-Tech & Electronic Ind.*, Sept. 1955, Vol. 14, No. 9, pp. 56–57 ..120.) The short-circuit current-amplification factor of *p-n-p* junction transistors is measured by means of a battery-operated single-meter instrument, a 10-μA drop in base current being used as a step-waveform input signal.

621.317.7 : 621.396.822 **527**

Direct-Reading Noise-Figure Indicator.—C. E. Chase. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 161–163.) An instrument for measurements on travelling-wave valves etc. comprises a noise source modulated by a 60-c/s square wave, the noise figure being given by the noise-source power less the difference in dB between the modulated and unmodulated output components, assuming linear amplification and quadratic detection. A special feature is the use of simple circuits to take the logarithms of these two voltages and derive their difference, giving an indication which is linear on a dB scale.

621.317.725 **528**

Square-Law Detector for R.M.S. Voltages.—J. W. Sauber. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 170–172.) A voltmeter of amplifier-detector type is described in which an approximately parabolic characteristic consisting of linear segments is obtained by use of a series arrangement of biased Ge diodes. The voltage range is up to 320 V, the frequency range is from 5 c/s to 500 kc/s.

621.317.733 : [621.373.5+621.375.4 **529**

Low-Cost, Battery-Operated Oscillators and Detectors for A. C. Bridges.—M. D. Armitage. (*J. sci. Instrum.*, Aug. 1955, Vol. 32, No. 8, pp. 300–302.) A transistor oscillator with an output of 1 V across 1 000 Ω and a transistor transformer-coupled amplifier detector which will detect 0·01 mV are described; complete circuit diagrams are given.

621.317.75 **530**

The Writing Speed of Light-Beam Oscillographs.—W. Härtel. (*Frequenz*, Sept. 1955, Vol. 9, No. 9, pp. 319–324.) The performances of cathode-ray and light-beam oscillographs are compared; the maximum writing speed of the latter type is about 1·5 km/s.

621.317.75.088 **531**

The Accuracy of Estimation of Oscillograms.—W. Härtel. (*Frequenz*, Aug. 1955, Vol. 9, No. 8, pp. 264–273.) Discussion of errors in estimating photographed curves, due to inaccuracy of the observer rather than of the measurement apparatus.

621.317.755 : 537.52 **532**

The Plasmograph, a New Instrument for studying Periodically Variable Electric Discharges.—R. Ledrus, M. Hoyaux & A. Vanavermaete. (*Rev. gén. Élect.*, Aug. 1955, Vol. 64, No. 8, pp. 391–403.) Description of a c.r.o. instrument based on application of the theory of the Langmuir probe.

621.317.763.029.64 : 621.396.96 **533**

A Simplified Form of Microwave Interferometer for Speed Measurements.—G. W. G. Court. (*J. sci. Instrum.*, Sept. 1955, Vol. 32, No. 9, pp. 354–356.) The instrument described is suitable for the determination of the Doppler frequency shift due to the motion of a target. One aerial is used and a hybrid ring junction separates the transmitting and receiving paths, leakage from the transmitter providing local-oscillator power for the receiver.

621.317.784.029.62 **534**

A Wide-Band V.H.F. Wattmeter.—T. Takahashi & M. Arai. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 99–105.) A resistance-loop directional coupler working through a coaxial line into a sensitive square-law valve voltmeter shunted by a variable capacitance is used to measure power in a transmission line. Wide-band characteristics are achieved by careful design of the coupler to secure that its resistance does not vary with frequency and by compensation in the measuring circuit for the variation of coupling coefficient with frequency. The instrument described measures power up to 60 W with an accuracy within 5% over the frequency range 30–200 Mc/s.

621.317.794 : 621.396.822 **535**

A Comparison of Two Radiometer Circuits.—S. J. Goldstein, Jr. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1663–1666.) A comparison is made between Dicke's method of measuring noise radiation (475 of 1947) and the method based on absence of correlation in noise received by two independent receivers. Expressions are derived for the weakest detectable signal in both methods; the two-receiver method is the more sensitive.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

535.24-1.08.7 : 621.383.4 **536**

Portable Radiation Detectors employing Photoconductive Cells.—J. C. S. Richards. (*J. sci. Instrum.*, Sept. 1955, Vol. 32, No. 9, pp. 340–343.) The design of battery-operated infrared-radiation detectors is discussed. Use of an electromagnetically maintained vibrating-reed shutter for chopping the incident radiation leads to an acceptable signal/noise ratio.

621.3.078(47) : 016 **537**

List of U.S.S.R. Literature on Automatic Regulation and Related Problems for 1954.—(*Avtomatika i Telemekhanika*, March/April & May/June 1955, Vol. 16, Nos. 2 & 3, pp. 219–224 & 317–320.) A bibliography of about 250 papers.

621.384.612 **538**

The Glasgow 340-MeV Synchrotron.—W. McFarlane, S. E. Barden & D. L. Oldroyd. (*Nature, Lond.*, 8th Oct. 1955, Vol. 176, No. 4484, pp. 666–669.) Illustrated description of a machine in use for experiments on the photodisintegration of nuclei and for meson physics.

621.385.833 **539**

The Lower Limit of the Aperture Error in Magnetic Electron Lenses.—W. Tretner. (*Optik, Stuttgart*, 1955, Vol. 12, No. 6, p. 293.) Correction to paper abstracted in 236 of 1955.

621.385.833 **540**

A Compact Console-Type Electron Microscope.—R. S. Page. (*Metrop. Vick. Gaz.*, Aug. 1955, Vol. 26, No. 433, pp. 248–254.) Description of the Type-EM4 model, a general-purpose instrument which can be used for reflection electron microscopy with non-ferrous specimens, as well as for the transmission type of record.

PROPAGATION OF WAVES

621.396.11 **541**

Propagation of Electromagnetic Waves over a Flat Earth across a Boundary separating Different Media, and Coastal Refraction.—K. Furutsu. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. pp. 1–49.) The general equation is formulated for vertically polarized waves in three-dimensional space, based on the Hertz vector, the analysis being valid for the case when the horizontally polarized wave induced at the boundary is negligible. A more general formulation is given in an appendix. The results are essentially the same as those obtained by Clemmow (3688 of 1953) for two-dimensional space. The refraction angle at a coast line is determined and the treatment is extended to propagation across successive lines of discontinuity.

621.396.11 **542**

Measurement of Field Intensity of Ground Wave over Mixed Paths.—Y. Aono & K. Muramatsu. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 51–58.) Observations on frequencies from 1·85 to 4 Mc/s over mixed country near Tokyo, including both land and water, gave results in accordance with the theory of Furutsu (541 above).

621.396.11 **543**

Automatic Recording of the Direction of Arrival of Radio Waves reflected from the Ionosphere.—J. A. Thomas & R. W. E. McNicol. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 793–799.) The direction of arrival of 2·28-Mc/s echoes was measured using technique based on that of Ross et al. (2804 of 1951) and modified to record automatically the direction of arrival of all the resolved echoes. Signals proportional respectively to the vector sum and difference of the signals induced in two spaced aerials were amplified in separate receivers and the rectified outputs were displayed on a c.r.o. whose timebase was synchronized with the transmitter pulses. The display was photographed with successive 3-min exposures. The system was stable enough to run without attention for a week. Typical records are reproduced.

621.396.11 : 550.372 **544**

Variations of the Phase Constant of the Ground Wave.—M. Argirovic. (*Onde élect.*, July 1955, Vol. 35, No. 340, pp. 687–691.) Analysis presented previously (3687 of 1953) is extended to deal with propagation at frequencies higher than those used for broadcasting. Curves are presented showing the variation of the field strength and of the equivalent phase constant with distance for different values of ground constants and frequency.

621.396.11 : 551.510.5 **545**

On the Propagation of the Electromagnetic Waves in an Inhomogeneous Atmosphere.—Y. Nomura & K. Takaku. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 709–714.) A rigorous solution is obtained of Maxwell's equations for propagation in an inhomogeneous medium in which the dielectric constant is proportional to r^{2m}, where r is the distance from the centre of the earth. The expression for the dipole field in such a medium is generalized to apply in a medium in which the dielectric constant is an arbitrary function of r and is further transformed into a contour integral in a form convenient for calculations by the saddle-point method. Geometrical expressions are also derived for waves propagated in a duct.

621.396.11 : 551.510.535 **546**

The Reflexion of Vertically Incident Long Radio Waves from the Ionosphere when the Earth's Magnetic Field is Oblique.—J. Heading. (*Proc. roy. Soc. A.*, 6th Sept. 1955, Vol. 231, No. 1186, pp. 414–435.) The ionosphere is considered as comprising a lower region, in which the influence of collision frequency is

important, and an upper region in which the influence of the magnetic field predominates. The equations for the lower region are solved for an exponential distribution of electron density; those for the upper region are solved for the case of oblique propagation when the plane of incidence coincides with the magnetic meridian. Expressions are obtained for the reflection and transmission coefficients of the lower region and for the reflection and conversion coefficients of the upper region.

621.396.11 : 551.594.5 **547**

Auroral Echoes observed North of the Auroral Zone on 51·9 Mc/s.—Dyce. (See 429.)

621.396.11 : 551.594.5 **548**

Double-Doppler Radar Investigations of Aurora.—McNamara. (See 428.)

621.396.11.029.55 : 621.396.824 **549**

Some Considerations on Measurement of Bearings of the Incoming Short Waves: Part 2.—I. Kasuya. (*J. Radio Res. Labs, Japan*, Jan. 1955, Vol. 2, No. 7, pp. 77–83.) The measurements described in part 1 (2091 of 1955) were continued during a period of disturbed ionospheric conditions (18th–24th March 1954); previous conclusions regarding the effect of ionosphere tilting on lateral deviation are confirmed. Examples are given of lateral deviations corresponding to tilts in directions other than E–W. Tilting may correspond to curvature of the ionosphere with a space periodicity of 10–100 km.

621.396.11.029.62 : 621.396.82 **550**

Long-Distance V.H.F. Interference [in Britain].—T. W. Bennington. (*Wireless World*, Dec. 1955, Vol. 61, No. 12, pp. 592–596.) In conditions of abnormal propagation interference may be caused by stations distant 200–1 400 miles. The effect may be due to (*a*) intense ionospheric E_s, which permits propagation of frequencies up to about 60 Mc/s for about 1% of the time, mainly during summer daytime, or more frequently, (*b*) tropospheric inversion layers, which may produce interference over the frequency band 40–100 Mc/s at ranges up to 500 miles. The effects are unlikely to be serious for the f.m. sound services since strong signals in f.m. receivers tend to suppress weaker ones.

RECEPTION

621.396.62 : [621.376.23 + 621.376.33] **551**

A.M.-F.M. Demodulator.—P. Kundu. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, p. 337.) A demodulation method is outlined based on the variation of slope of the flanks of pulses obtained by limiting sinusoidal signals. See also 2737 of 1955 (Das).

621.396.62 : 621.376.3 **552**

Causes of the 'Spitting' Effect in U.S.W. Transmission.—E. Belger. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 7/8, pp. 149–150.) Discussion of a defect observed in f.m. reception when the receiver bandwidth is too narrow; the effect is due to spurious amplitude modulation resulting from frequency deviations on the flanks of the filter characteristics.

621.396.62.012.3 **553**

Noise Factor Nomograph.—S. McCarrell. (*Electronics*, Nov. 1955, Vol. 28, No. 11, p. 174.) A chart for receiver design is presented, relating bandwidth, noise factor and power in the aerial circuit.

621.396.621 **554**

Sensitive Three-Valve T.R.F. Receiver.—H. E. Styles. (*Wireless World*, Dec. 1955, Vol. 61, No. 12, pp. 616–620.) The receiver incorporates the amplified a.g.c. system described by Amos & Johnstone (1092 of 1952) and the negative-feedback volume control described by Osbourne (*ibid*, April 1954, Vol. 60, No. 4, pp. 165–168).

621.396.621.54 **555**

On the Principle and Design of a Trigger Circuit of a Signal-Seeking Radio using 'Difference-Voltage'.—Chih Chi Hsu. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1591–1607.) Detailed discussion of the operation of a receiver in which the signal-seeking circuit is switched off, when the signal is found, by a pulse corresponding to the difference between the secondary and primary voltages of the i.f. output transformer. The arrangement provides constant anticipation in face of signal-strength variations; a simple expression is derived for the amount of anticipation. Errors arising in the trigger circuit and those due to nonlinearity of the tuner are examined. Numerical examples are given.

621.396.621.54.029.53/.55 **556**

Frequency Stability and Setting Accuracy of the Short-Wave Communication Receiver E 104.—W. Hasselbeck. (*Telefunken Ztg.*, March 1955, Vol. 28, No. 107, pp. 39–45. English summary, p. 61.) The receiver is mains-operated and covers the frequency range 1·1–30 Mc/s in 17 bands. The first i.f. is variable, the local oscillator being crystal controlled. The second i.f. is fixed at 525 kc/s. Methods of ensuring high frequency stability are described, including special elastic couplings for the tuning capacitors. The 'setting accuracy' of the frequency adjustment, considering all possible sources of error, is calculated on a basis of 99·7% probability to be within 1·5 kc/s.

621.396.822 **557**

Statistical Characteristics of Noise in the Presence of a Carrier Wave.—E. Divoire. (*Rev. HF, Brussels*, 1955, Vol. 3, No. 3, pp. 93–106.) Analysis is presented for a system using a linear detector and the results are compared with those obtained experimentally; the assumption of a Gaussian noise distribution appears to be justified.

621.396.822 : 621.317.794 **558**

A Comparison of Two Radiometer Circuits.—Goldstein. (See 535.)

STATIONS AND COMMUNICATION SYSTEMS

621.39 **559**

I.R.E. Symposium on Global Communications, Washington, D.C., June 23–25, 1954.—(*Trans. Inst. Radio Engrs*, Nov. 1954, Vol. CS-2, No. 3, pp. 1–112.) The text is given of over 20 papers presented.

621.39 **560**

I.R.E.-A.I.E.E. Symposium on Military Communications, New York, N.Y., April 28, 1954.—(*Trans. Inst. Radio Engrs*, Nov. 1954, Vol. CS-2, No. 3, pp. 113–173.) The text is given of 12 papers of which all but one were presented at the symposium, and all are reprinted from *Trans. Amer. Inst. elect. Engrs, Communication and Electronics*, November 1954.

621.39 : 621.376.5 **561**

Signal Analysis and Audio Characteristics of Pulse-Slope Modulation.—J. Das. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 482–487.) Further theoretical and experimental work on the method described previously (2737 of 1955) is reported. Working with a pulse repetition frequency of 10 kc/s and pulse duration of 10 μs, the modulation is linear over an input a.f. volume range of 35 dB; the a.f. gain of the system is constant within ± 5 dB up to 3 kc/s and average distortion is $< 5\%$ for an input volume variation of 30 dB.

621.39.001.11 : 621.376.5 **562**

Electrical Pulse Communication Systems: Part 2—Message Encoding and Signal Formation in Pulse Systems.—R. Filipowsky. (*J. Brit. Instn Radio Engrs*, Oct. 1955, Vol. 15, No. 10, pp. 483–504.) "Five specifications should be known of an information source: dimensionality; maximum information content and peak rate of information production; average rate of information production; auto-correlation function; and statistical fine structure of the source. Various sources are discussed with reference to the specifications. Message encoding is split into two distinct operations: space matching and entropy matching. The former process has to reduce the dimensionality of the message space to match the three-dimensional signal space, the latter has to remove redundancy. Signal formation involves sampling, quantization and pulse modulation. The typical pulse waveforms are compared and their frequency spectra are listed. Signal encoding is considered as a linear transformation of the signal space into the channel space for the sole purpose of matching it to the requirements of a noisy channel of limited bandwidth." Part 1: 261 of January.

621.394.5/.6 **563**

Signalling Systems for Submarine Telegraph Circuits.—C. J. Hughes. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 831–835.)

621.396.3 **564**

Multiple-Frequency-Shift Teletype Systems.—D. B. Jordan, H. Greenberg, E. E. Eldredge & W. Serniuk. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1647–1655.) By shifting the carrier to one of a number of different frequencies instead of, as in ordinary frequency-shift keying, only one, it is possible to extend the pulse duration without lowering the transmission rate, so that narrower detection bandwidths can be used, with improved signal/noise ratio and reduced errors. Analysis is presented based on information theory. Detailed calculations are made for a 6-frequency and a 32-frequency system. Two-frequency equipment can be adapted; circuits for coding, filtering, etc. are described and experimental results reported.

621.396.4 : 621.396.65 **565**

An Introduction to some Technical Factors affecting Point-to-Point Radiocommunication Systems.—F. J. M. Laver. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 733–743.) A survey covering information-theory aspects, transmission systems, propagation factors, and coding, modulating and multiplexing methods; 100 references.

621.396.41 : 621.376.5 **566**

Quadriphase—A New Approach to Time-Division Multiplexing.—W. E. Evans & R. F. Lowe. (*Elect. Engng, N.Y.*, Aug. 1955, Vol. 74, No. 8, pp. 685–688.) Digest of paper to be published in *Trans. Amer. Inst. elect. Engrs, Power Apparatus and Systems*, 1955. The control of the timing in the various channels is derived from a system of four sinusoidal oscillations at sampling frequency, with 90° phase spacings, using resistance networks to obtain the intermediate phases.

621.396.41 : 621.396.11.029.6 **567**

System Parameters using Tropospheric Scatter Propagation.—H. H. Beverage, E. A. Laport & L. C. Simpson. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 432–457.) "Accumulated data from published sources and from unpublished research on tropospheric forward scatter propagation are reviewed and condensed for practical application to FM communication systems. Antennas suitable for use on scatter paths are reviewed and the limitations on usable gains are discussed. General design methods for FM systems are presented and reduced to a design chart that includes the relationship of all parameters in a frequency-division multiplexed FM telephone system. Then follow computed values of transmitter power as functions of distance, frequency and antenna size for a number of systems of practical interest using tropospheric forward scatter."

621.396.41 : 621.396.65.029.6 **568**

Wide-Band Microwave Radio Links.—S. Fedida. (*Marconi Rev.*, 3rd Quarter 1955, Vol. 18, No. 118, pp. 69–94.) "A broad survey of the techniques used in the construction of wideband microwave links is given, with particular emphasis on the applications of travelling wave-tubes, in these links. Some of the design requirements are examined in the light of the conclusions of the C.C.I.R. Study Group IX, meeting at Geneva, at the end of 1954."

621.396.71 **569**

Rugby Radio Extension.—(*Elect. J.*, 5th Aug. 1955, Vol. 155, No. 6, p. 461.) Brief description of the British Post Office station extension opened in July 1955 and housing 28 30-kW transmitters for the frequency range 4–27·5 Mc/s, controlled from a central cabin.

621.396.931 **570**

The Use of Radiotelephony for the Control of Works Transport.—E. N. Farrar & M. T. O'Dwyer. (*J. Brit. Instn Radio Engrs*, Oct. 1955, Vol. 15, No. 10, pp. 519–525.)

SUBSIDIARY APPARATUS

621-526(083.74) **571**

IRE Standards on Graphical and Letter Symbols for Feedback Control Systems, 1955.—(*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1608–1609.) Standard 55 I.R.E. 26.S1.

621.311.6 : 621.316.722.1 **572**

Low-Ripple Adjustable Regulated Power Supply.—G. Hetland, Jr, & R. R. Buss. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 164–165.) A unit giving an output of 350–1 000 V with an output impedance $> 10\Omega$ is described.

621.314.1 : 621.373.52 : 621.314.7 **573**

Transistor D.C. Converters.—L. H. Light & P. M. Hooker. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 775–786. Discussion, pp. 786–792.) A transistor in a relaxation oscillator is arranged to interrupt a l.v. circuit; energy is stored in the transformer inductance during the 'on' period and is delivered to the output circuit at an increased voltage during the 'off' period, the circuit thus acting as a step-up device. Design and operation of practical arrangements are discussed. A shorter account of the work is given in *Wireless World*, Dec. 1955, Vol. 61, No. 12, pp. 582–586.

621.314.63 **574**

Germanium Power Rectifiers.—G. A. Carrick. (*Trans. S. Afr. Inst. elect. Engrs*, July 1955, Vol. 46, Part 7, pp. 197–211. Discussion, pp. 211–217. Paper reprinted in *B.T.-H. Activ.*, Nov./Dec. 1955, Vol. 26, No. 6, pp. 173–185.)

621.316.722.1 **575**

Improving the Performance of the Series Electronic Voltage Regulator.—G. H. T. Hatton. (*Proc. Instn Radio Engrs Aust.*, Sept. 1955, Vol. 16, No. 9, pp. 308–311.) "Compensating networks for improving the performance of the conventional series electronic voltage-regulator circuit are analysed. The theory is compared with measurements made on a fully compensated circuit."

621.316.722.1 **576**

Effects of Heater-Voltage Variations of Valves in Certain Stabilizer Circuits.—F. A. Benson & G. V. G. Lusher. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 502–505.) Calculations further to those presented previously (1925 of 1954) show that, in series-parallel stabilizer circuits having a resistor in the cathode lead of the amplifier, the effect of heater-voltage variations is not serious because the two valves produce output-voltage changes of opposite sign.

TELEVISION AND PHOTOTELEGRAPHY

621.397.242 **577**

Television Transmission on Cables.—K. Barthel. (*Arch. elekt. Übertragung*, Aug. 1955, Vol. 9, No. 8, pp. 341–349.) Distortion produced by s.s.b. transmission can be corrected by (*a*) multiplicative mixing at the far end with a carrier of exactly correct phase, or (*b*) modulation to a depth > 100% so as to provide favourable operating conditions for the line amplifiers. Correction of distortion introduced by the line itself is performed by attenuation and phase equalizers; arrangements appropriate for line sections of average length 9·3 km transmitting frequencies from 300 kc/s to 6·2 Mc/s are briefly indicated.

621.397.26 : 621.396.65.029.6 **578**

Microwave Television Transmission Systems.—W. L. Wright. (*Marconi Rev.*, 3rd Quarter 1955, Vol. 18, No. 118, pp. 95–118.) The suitability for television purposes of the microwave radio links discussed by Fedida (568 above) is compared with that of cable relay systems. Modulation and demodulation equipment is described with special consideration of the design of f.m. oscillators.

621.397.335 : 621.3.018.75 **579**

Television Sync-Pulse Spectrum.—W. T. Cocking. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, pp. 313–315.) Fourier-series calculations relating to nonsinusoidal waveforms can be simplified by adding or multiplying some well known series. The structure of the British television synchronizing signal is considered as an example of application of this method.

621.397.5 : 535.623 **580**

The ABC's of Color Television.—J. M. Barstow. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1574–1579.) A description of the N.T.S.C. system in a form suitable for nonspecialist engineers.

621.397.5 : 535.623 **581**

Colour Television in the U.S.A.—C. G. Mayer. (*Electronic Engng*, Nov. 1955, Vol. 27, No. 333, pp. 488–491.) A brief review of progress made since the previous report (3367 of 1954).

621.397.5 : 535.623 **582**

A Sequential System of Image Transmission in Natural Colours.—A. M. Varbanski. (*Vestnik Svyazi*, 1955, No. 3, pp. 6–9.) The physiology of colour vision is discussed and a sequential system of colour television adopted at the Moscow Experimental Station for Colour Television is described. The distortion peculiar to this type of transmission is considered, and also the special requirements imposed on film transmission.

621.397.5 : 535.623 **583**

Differential Chromaticity Thresholds in the Direction of Primary Blue in a Trichromatic-Synthesis System.—P. Billard. (*Rev. d'Optique*, July/Aug. 1955, Vol. 34, Nos. 7/8, pp. 371–405.) Detailed report of experiments made in connection with colour-television studies. The results indicate that different colours should be compared at the maximum brightness levels which they can attain in a trichromatic synthesis. This applies particularly for hues close to primary blue; if the comparison is made with the colours at the same brightness level the sensitivity of the eye to small chromaticity differences is overestimated.

621.397.6 **584**

Phase Pre-correction in Television Transmitters and Receivers.—J. Peters. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 7/8, pp. 125–128.) Results of a comprehensive investigation are reviewed. Mathematical analysis of transients indicates that picture quality is effectively improved by phase equalization in the video-frequency channel only; these results are confirmed by measurements. Reasons are given for effecting the equalization entirely at the transmitter.

621.397.6 : 622.4 **585**

Operation of Television Installations in Open-Cast Lignite Mining.—W. Meyer. (*Elektrotech. Z., Edn B*, 21st Aug. 1955, Vol. 7, No. 8, pp. 286–289.) Operation in mines spanning the range from 117 m above sea level to 77 m below sea level is discussed. Television equipment is particularly useful for the dredger-man, since dredgers 90 m long may be used. Equipment is described with special reference to requirements for dust exclusion and proper illumination.

621.397.6 : 778 **586**

Simple Equipment for obtaining Photographs of Single Television Pictures.—W. Dillenburger & J. Wolf. (*Frequenz*, Sept. 1955, Vol. 9, No. 9, pp. 296–298.) A switching circuit is described for producing a single-scan picture with the same brightness values as in continuous operation.

621.397.6.001.4 **587**

The Test-Line Technique in Television.—H. E. Fröling. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 7/8, pp. 129–138.) Details are given of a method in which a special signal for testing transmission characteristics during a programme is inserted at the end of the vertical blanking interval so as not to appear in the ordinary picture. The test waveform may include white, black and grey levels, as well as pulses for testing linearity, reflections and amplitude and phase variations.

621.397.61 : 535.623 **588**

Matrixing and encoding Color for Telecasting.—H. Taub, J. Rabinowitz, D. Schacher & M. Star. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 140–145.) Details are given of a unit which accepts as inputs the blanking, synchronizing, subcarrier, burst-key and individual

colour signals and forms them into the composite signal appropriate for feeding to a transmitter operating on the N.T.S.C. colour-television system.

621.397.61 : 778.55/.6 **589**

Control of Light Intensity in Television Projectors.—K. Sadashige & B. F. Melchionni. (*J. Soc. Mot. Pict. Telev. Engrs*, Aug. 1955, Vol. 64, No. 8, pp. 416–419.) The problem discussed is that of controlling the intensity of the source illuminating colour film when using a vidicon camera tube, so as to maintain the video signal level independent of the average film density. An equipment is described in which the compensation is effected by controlling the angular position of a filter wedge in the projector condenser lens by means of a servomechanism.

621.397.61.001.4 **590**

Test Equipment for the Belgian Television Transmitters.—W. Hamoir. (*Rev. HF, Brussels*, 1955, Vol. 3, No. 3, pp. 107–116.)

621.397.611.2 **591**

The Development of the C.P.S.-Emitron Television Camera Tube.—J. D. McGee. (*Arch. elekt. Übertragung*, Aug. 1955, Vol. 9, No. 8, pp. 355–362.) Refinements incorporated in later versions of this tube include use of a mesh close in front of the target to stabilize the tube against extra-strong illumination, and use of slightly conducting glass as the material for the target plate to increase the storage capacity and thus extend the contrast range without introducing time lag.

621.397.62 **592**

Circuits and Components for 90° Scanning.—(*Mullard tech. Commun.*, Aug. 1955, Vol. 2, No. 14, pp. 89–111.) The issue includes papers on line and frame timebase circuits for 90° scanning, together with some details of the deflection units, c.r. tubes and valves.

621.397.62 : 621.373.4 **593**

Frequency Characteristics of Local Oscillators.—W. Y. Pan. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 379–397.) An examination is made of the effect on frequency stability of the heat developed during operation in local oscillators used in v.h.f. and u.h.f television receivers. Compensation methods, especially for the warm-up period, are indicated.

621.397.62 : 621.375.221.029.62 **594**

Phase-Linear Television Receivers.—A. van Weel. (*Philips Res. Rep.*, Aug. 1955, Vol. 10, No. 4, pp. 281–298.) A receiver with phase-linear i.f. amplifier is described, using conventional circuits and giving normal selectivity. The performance compares favourably with that of receivers in which phase errors are compensated in the video-frequency stages of either transmitter or receiver.

621.397.8 **595**

The Fixing of Nonlinearity Tolerances for Television Transmission Systems.—S. Funk. (*NachrTech.*, Aug. 1955, Vol. 5, No. 8, pp. 347–350.) The permissible nonlinearity is discussed in relation to the physiology of vision; a maximum picture contrast of about 1 : 100 is assumed, with a grey scale of 20 distinguishable steps. In relation to a normalized system transfer characteristic with unity slope, the tolerance on the slope is about 10% up or down. A special signal and test method are described for adjusting the system to conform to these tolerances.

621.397.8 **596**

The Influence of the Optical System on the Modulation Depth in Television Pickup Devices.—W. Dillenburger. (*Frequenz*, Sept. 1955, Vol. 9, No. 9, pp. 293–296.) Measurements on known types of objective are reported. It is possible to stop them down so that in practice they have no influence on the frequency variation of modulation depth. Loss of modulation is bound to occur when a television picture is recorded and rescanned or when a standards conversion is effected.

TRANSMISSION

621.396.61 : 621.376.222 **597**

Series Tube modulates Amplifier Screen-Grid.—W. B. Bernard. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 158–160.) Low-level modulation circuits are discussed in which the modulating valve is in series with the screen-grid supply to the modulated amplifying valve. Modulating signals ranging from d.c. to very high frequency can be handled. Arrangements are described using feedback to correct a nonlinear relation between the screen-grid voltage and the power output. A circuit for protecting the modulated valve is also described. The system simplifies controlled-carrier operation.

VALVES AND THERMIONICS

621.314.63 **598**

The Dependence of the Current Density of a *p-i-n* Rectifier on the Width of the Intermediate Zone.—A. Herlet. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 335–345.) The current density increases with increasing intermediate-zone width for values of the latter up to twice the carrier-diffusion length, but decreases for intermediate-zone widths greater than this. The mechanism is discussed on the basis that in the first case the separate zones constitute current sources which act in combination, while in the second case the paths in the different zones combine as for ordinary series resistances.

621.314.63 : [546.28 + 546.289 **599**

On the Inductive Part in the A.C. Characteristic of the Semiconductor Diodes.—Y. Kanai. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 719–720.) The susceptance of Si and Ge *p-n* junction diodes was determined at frequencies from 3 kc/s to 5 Mc/s. With a forward bias voltage the susceptance decreased at high frequencies, the experimental results thus deviating from Shockley's theory. This decrease can be explained by postulating a series inductive component associated with the conductivity modulation caused by hole injection.

621.314.63 + 621.314.7] : 621.396.822 **600**

Theory of Shot Noise in Junction Diodes and Junction Transistors.—A. van der Ziel. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1639–1646.) Noise caused by random diffusion of minority carriers and random recombination of minority and majority carriers is investigated by means of a transmission-line analogy proposed by North, in which the diffusion corresponds to the presence of series noise-voltage generators while the recombination corresponds to parallel noise-current generators. For low frequencies the equivalent circuits thus derived correspond to those derived previously, but for high frequencies the new method gives a more accurate representation of the noise properties. The theory takes account of volume recombination only.

621.314.632 : 621.396.822 **601**

Noise in Silicon Microwave Diodes.—G. R. Nicoll. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 786–792.) Discussion on 294 of 1955.

621.314.7 **602**

Transistors and their Production.—J. Malsch. (*Elektrotech. Z., Edn B*, 21st Aug. 1955, Vol. 7, No. 8, pp. 273–278.) A survey including a brief illustrated account of the production of alloyed-junction transistors.

621.314.7 **603**

'Step' and 'Oscillation' Phenomena in the Collector of A-Type Transistors.—M. Kikuchi & Y. Tarui. (*J. phys. Soc. Japan*, Aug. 1955, Vol. 10, No. 8, pp. 722–723.) Further investigation of the 'step' effect (880 of 1955), using the transistor collector as a diode and the emitter as subsidiary electrode, showed that the 'step' occurred earlier in the presence of hole current from the emitter. An 'oscillation' in the collector voltage was sometimes observed, following just after the 'step'. An oscillogram is shown and a possible explanation of the phenomenon is very briefly discussed. See also 3070 of 1954 (Lempicki & Wood).

621.314.7 **604**

Self-Bias Cut-Off Effect in Power Transistors.—N. H. Fletcher. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, p. 1669.) Analysis is given which is valid for higher levels of injected-carrier density than those discussed previously (2463 of 1955).

612.314.7 : 621.317.7 **605**

Simplified Transistor Test Equipment.—Bentley, Ghandi & Mathis. (See 526.)

621.314.7 : 621.396.822 **606**

Measurements of Junction-Transistor Noise in the Frequency Range 7-50 kc/s.—W. L. Stephenson. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 753–756. Discussion, pp. 786–792.) The measurements were made using a superheterodyne arrangement with narrow-band filter in the i.f. amplifier, giving constant bandwidth over the frequency range; the influence of collector voltage and current and of temperature was studied. Results are analysed on the basis of two equivalent noise generators in the input circuit; they indicate that (*a*) the noise factor exhibits a minimum at about 25 kc/s, (*b*) the optimum source resistance is independent of frequency, (*c*) the optimum source resistance is not directly related to the input resistance, and (*d*) the noise is independent of collector voltage.

621.314.7.012.8 **607**

The Natural Equivalent Circuit of Junction Transistors.—J. Zawels. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 360–378.) The equivalent circuit is derived by considering the details of transistor action, the method being a generalization of that presented previously (300 of 1955). The resulting circuit comprises a passive network in cascade with a frequency-independent amplifier. A method is indicated for computing the parameters of the equivalent circuit from spot measurements of the *h* parameters.

621.383.2 **608**

New Photoemissive Cathodes of High Sensitivity.—A. H. Sommer. (*Rev. sci. Instrum.*, July 1955, Vol. 26, No. 7, pp. 725–726.) Photocathodes consisting of Sb and more than one alkali metal in combination show much higher sensitivity in the visible spectrum, especially to red light, than those containing only one such metal.

621.383.2 **609**

Discontinuities in the Saturation Curves of Vacuum Photocells.—J. S. Preston & G. W. Gordon-Smith. (*Brit. J. appl. Phys.*, Sept. 1955, Vol. 6, No. 9, pp. 329–333.) Conditions under which certain types of photoemissive cell can operate in either of two stable states are discussed. The best conditions for saturation and regular behaviour are obtained if the inner surface of the envelope is highly conducting and is in good connection with the anode, but insulated from the cathode.

621.383.27 **610**

Instability of Photomultipliers.—L. P. de Valencé. (*Brit. J. appl. Phys.*, Sept. 1955, Vol. 6, No. 9, pp. 311–313.) Dark-current instability of certain types of electrostatically focused tubes operated with cathode at high negative potential is ascribed to defocusing effects between the photocathode and first dynode and to positive envelope potentials. Stability is secured by connecting the glass envelope to the cathode or second dynode.

621.383.4 **611**

High-Sensitivity Photoconductor Layers.—S. M. Thomsen & R. H. Bube. (*Rev. sci. Instrum.*, July 1955, Vol. 26, No. 7, pp. 664–665.) Microcrystalline powders of CdS or CdSe fixed with plastic material, or sintered on to suitable surfaces, give large-area layers having most of the desirable characteristics of single crystals, with advantages in increased red sensitivity, in the case of CdS layers, and in the ohmic character of sintered layers with silver-paste electrodes.

621.383.4 **612**

Large-Area High-Current Photoconductive Cells using Cadmium Sulfide Powder.—F. H. Nicoll & B. Kazan. (*J. opt. Soc. Amer.*, Aug. 1955, Vol. 45, No. 8, pp. 647–650.) Photoconducting layers are prepared from CdS powder, with particle sizes $< 50\,\mu$, and a binder such as ethyl cellulose or polystyrene. The layer is applied to a support such as glass by spraying, silk screening, etc. Various possible constructions are described; cells can readily be made capable of carrying photocurrents of 1A or more in room light. Build-up and decay time constants of the order of 0·1 sec have been obtained.

621.383.5 **613**

The Stability of Selenium Photocells.—H. Wörner. (*Z. Met.*, Aug. 1955, Vol. 9, No. 8, pp. 248–250.) Tests made on barrier-layer cells after two years' service indicate an appreciable decrease of sensitivity. The amount of the decrease varies greatly from cell to cell and may be as high as 30%; it depends on both fatigue and aging effects.

621.383.5 : 537.311.33 : 546.289 **614**

Influence of Diffusion Length and Surface Recombination on the Barrier-Layer Photoelectric Effect in Germanium.—H. U. Harten & W. Schultz. (*Z. Phys.*, 20th July 1955, Vol. 141, No. 3, pp. 319–334.) Photovoltaic cells of large area can be produced by evaporating a transparent gold film on to Ge plates. From the sensitivity/wavelength characteristic the diffusion length of the minority carriers can be deduced using 'thick' Ge plates, and the surface recombination velocity can be deduced using 'thin' plates.

621.383.5 : 621.314.63 : 621.375.3 **615**

A Germanium Diffused-Junction Photoelectric Cell.—J. M. Waddell, S. E. Mayer & S. Kaye. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6,

pp. 757–762. Discussion, pp. 786–792.) Descriptions are given of practical forms of a cell in which the *p-n* junction is produced by impurity diffusion; desirable features are low noise, high sensitivity, and extended long-wave response. Temperature rise is more important than absolute temperature level for determining the maximum ratings. Applications discussed include a magnetic amplifier making use of the high forward conductance of the cell.

621.385 + 621.314.7] : 621.396.822 **616**

Characterization of the Noise of Tubes and Transistors by Four Measurable Quantities.—H. Groendijk & K. S. Knol. (*Tijdschr. ned. Radiogenoot*, July 1955, Vol. 20, No. 4, pp. 243–256. In English.) The problem is investigated on the one hand by considering the mechanisms of noise production, and on the other by considering the valve or transistor as a linear quadripole. In general, the four measurable quantities characterizing the noise are not simply related to the physical phenomena giving rise to noise. The frequency dependence of the noise-characterizing quantities is discussed.

621.385.002.2 **617**

Thermionic Valves of Improved Quality for Government and Industrial Purposes.—E. G. Rowe, P. Welch & W. W. Wright. (*Proc. Instn elect. Engrs*, Part B, Nov. 1955, Vol. 102, No. 6, pp. 801–803.) Discussion on 2789 of 1955.

621.385.029.6 **618**

Focusing Electron Beams by Magnetic Fields.—W. Kleen & K. Pöschl. (*Arch. elekt. Übertragung*, July 1955, Vol. 9, No. 7, pp. 295–298.) A simplified analytical method is developed for determining the mean radius and the maximum radial expansion of a cylindrical beam from a concave cathode with either uniform or periodic magnetic focusing.

621.385.029.6 **619**

Theory of Coupled Space-Charge Waves.—F. Paschke. (*Frequenz*, Aug. 1955, Vol. 9, No. 8, pp. 273–279.) Pierce's theory developed for travelling-wave valves is extended by taking account of the displacement current in the direction of the beam. Calculation of the gain is reduced to a simple boundary-value problem. The theory is applicable only for very low beam current, very short wavelengths or very high coupling resistance. Calculations for an amplifier valve with two adjacent flat beams give a gain smaller by a factor of $1/\sqrt{2}$ than for a valve with overlapping beams.

621.385.029.6 **620**

The Carmatron, a New Electronically Tuned Wide-Band Oscillator.—R. Warnecke, J. Nalot, B. Epsztein & O. Doehler. (*C. R. Acad. Sci., Paris*, 12th Sept. 1955, Vol. 241, No. 11, pp. 695–698.) A valve combining desirable features of the magnetron and the M-type carcinotron has an axial cathode surrounded by a coaxial anode constituted by a slightly dispersive interdigital delay line. H.f. energy is extracted by a coaxial line. A magnetic field is applied in a direction such that the output and the end of the delay line are coupled not by the h.f. field but by the circulating electron beam. The valve will oscillate when the electron transit angle is a multiple of 2π. Electronic tuning bands of 25%–30% are possible in conjunction with high efficiencies. The theory has been verified by experiments on a valve for the 3-kMc/s band.

621.385.029.6 **621**

Periodic-Magnetic-Field Focusing for Low-Noise Traveling-Wave Tubes.—K. K. N. Chang. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 423–431.) The beam-focusing arrangements described comprise a magnet producing a uniform field in the gun region, a magnet system producing a space-periodic field in the helix region, and a matching device between the two. Measurements on a valve operating at 3 kMc/s indicate that gain and noise figures are comparable with those for a valve using a uniform focusing field.

621.385.029.6 **622**

Extension of 'The Effect of Initial Noise Current and Velocity Correlation on the Noise Figure of Traveling-Wave Tubes'.—W. R. Beam. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 458–460.) Amendments are proposed to the analysis presented by Bloom (3788 of 1955).

621.385.029.6 **623**

Positive-Ion Drainage in Magnetically Focused Electron Beams.—M. E. Hines, G. W. Hoffman & J. A. Saloom. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1157–1162.) Analysis is presented for the focusing of long electron beams when both axial magnetic field and space-charge neutralization by positive ions are operative. The theory is checked by measurements of the ion current collected from a long drift tube at various instants after application of a step signal. Results indicate that positive ions may be trapped at regions along the beam such that the axial variations of beam diameter are enhanced. See also 305 of 1955 (Ginzton & Wadia).

621.385.029.6 **624**

The Cascade Backward-Wave Amplifier: a High-Gain Voltage-Tuned Filter for Microwaves.—M. R. Currie & J. R. Whinnery. (*Proc. Inst. Radio Engrs*, Nov. 1955, Vol. 43, No. 11, Part 1, pp. 1617–1631.) Operation of the backward-wave valve as a narrow-band amplifier is discussed. A 'cascade' arrangement is described in which the beam traverses in succession a modulator helix, a drift tube or other intermediate section, and a demodulator helix. The valve can be tuned over a wide range of frequencies by varying the beam voltage, and the bandwidth can be controlled by stagger-tuning the input and output. The minimum noise figure should be of the same order as that of an ordinary travelling-wave valve, i.e. about 6 dB.

621.385.032.216 **625**

Changes in the Structure of Oxide Cathodes at High Temperatures.—H. P. Rooksby. (*Brit. J. appl. Phys.*, Aug. 1955, Vol. 6, No. 8, pp. 272–276.) Examination by X-ray microbeam technique indicates that as a result of heat treatment, at 900°–1150°C with BaO and 1100°–1250°C with SrO, crystallites of dimensions 2–5 μ are normally developed. A gradual increase in the structure-cell dimensions takes place with increasing temperature of heating in vacuum; this is attributed to a progressive increase in the numbers of lattice defects and in the case of BaO appears to correspond with the process of thermionic activation.

621.385.032.216 **626**

Oxide-Impregnated Nickel-Matrix Cathode.—W. Balas, J. Dempsey & E. F. Rexer. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1163–1165.) Description of the preparation and performance of a dispenser-type cathode with properties intermediate between those of the L type and those of the ordinary oxide cathode.

621.385.032.216 **627**

An X-Ray Study of Barium-Strontium-Calcium Triple Oxide.—J. Terada. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 555–565.) The experimental results are discussed; the increased emission of the triple oxide over that of a double or single oxide may be due to the increased possibility of crystal distortion by a given heat treatment.

621.385.032.216 **628**

Emission from Hollow Cathodes.—K. M. Poole. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, pp. 1176–1179.) Experimental evidence indicates that the emission from an internally coated hollow cathode includes a component from cathode material deposited round the opening, this subsidiary component becoming saturated at lower anode voltages than the main component.

621.385.032.216 : 546.431/.432]-31 **629**

On the Relations between Electron Emission, Conduction and Noise of Oxide-Coated Cathodes.—J. Nakai, Y. Inuishi & Y. Tsung-Che. (*J. phys. Soc. Japan*, June 1955, Vol. 10, No. 6, pp. 437–443.) Experimental results of measurements on (Ba, Sr)O cathodes are presented graphically and discussed with reference to the pore-conduction mechanism considered earlier by Young (896 of 1953) and others.

621.385.032.216 : 621.375.9 **630**

Properties of Pore Conductors.—R. Forman. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, p. 1187.) Following observations of anomalous conduction in oxide cathodes (2158 of 1955), experiments were made with porous thoria cylinders. At temperatures of 1 500°–1 600°C large transverse magnetoresistance effects were observed at comparatively low field strengths. An amplifying device is outlined based on the change of resistance of an oxide cathode coating subjected to variations of the e.s. field in front of it; the characteristics resemble those of a conventional triode.

621.385.032.216.2 **631**

Surface Treatment of Core Metal used for Oxide-Coated Cathode.—J. Nakai & S. Nakamura. (*J. phys. Soc. Japan*, July 1955, Vol. 10, No. 7, pp. 566–570.) Emission from oxide cathodes coated on to sleeves made of Ni containing 0·10% Mg and 0·17% Si as active materials can be increased by removing the surface contamination on the sleeves by an electrolytic treatment. The increased emission is probably due to the active material in the sleeve producing excess Ba by reduction of the cathode oxide.

621.385.032.24 **632**

Decrease of Grid Emission by Improvement of Electroplating.—T. Hashimoto & A. Yokoyama. (*Rep. elect. Commun. Lab., Japan*, May 1955, Vol. 3, No. 5, pp. 12–14.) An experimental investigation is reported of plating techniques for improving the adhesion of Au coatings deposited on valve grids to inhibit emission. Use of a thin layer of Pt over the Au is discussed. Both Mo and Ni are considered as base materials.

621.385.13 : 621.373.4 : 537.5 **633**

The Appearance of some Oscillating Discharges.—T. K. Allen, R. A. Bailey & K. G. Emeleus. (*Brit. J. appl. Phys.*, Sept. 1955, Vol. 6, No. 9, pp. 320–322.) Hot-cathode rectifiers and thyratrons containing gas at pressures of the order of 10^{-3} mm Hg are found to generate internal oscillations in the cm-λ and dm-λ bands, probably due to interaction between the primary and plasma electrons. Observed phenomena are described and the mechanism of their production is discussed.

621.385.3 **634**

On the Electron-Optical Action of Grid Systems.—A. M. Strashkevich & A. S. Reyzlin. (*Radiotekhniha, Moscow*, Feb. 1955, Vol. 10, No. 2, pp. 66–71.) The design of any multi-electrode valve can be reduced to the design of a number of equivalent triodes. A precise formula is derived for determining the distribution of potential in a plane triode. The dependence of the position of the focus on the electrical and geometrical parameters is investigated.

621.385.4 **635**

A Beam Power Tube for Ultra-high-Frequency Service.—W. P. Bennett. (*RCA Rev.*, Sept. 1955, Vol. 16, No. 3, pp. 321–338.) Details are given of the construction and performance of the Type-6448 tetrode [see also 3770 of 1955 (Koros)]; some appropriate circuit arrangements are outlined.

621.385.832 : 535.371.07 **636**

Sedimentation of Fluorescent Screens in Cathode-Ray Tubes.—F. de Boer & H. Emmens. (*Philips tech. Rev.*, Feb. 1955, Vol. 16, No. 8, pp. 232–236.) The processes involved in sedimentation are discussed. The effect of gelatinizing agents on the screen adhesion is very pronounced; barium salts are preferred to potassium sulphate for their more rapid action in this respect. The use of radioactive tracers to analyse the screen composition is described.

621.385.832 : 535.371.07 **637**

Sticking Potential of C.R.T. Screens.—K. H. J. Rottgardt & W. Berthold. (*J. appl. Phys.*, Sept. 1955, Vol. 26, No. 9, p. 1180.) Experiments further to those described previously by Rottgardt et al. (2167 of 1955) indicate that the sticking potential of screens in sealed-off television tubes is not noticeably influenced by the vapours from the pumps used.

621.385.832.002.2 **638**

Cathode-Ray-Tube Manufacture.—(*Elect. Rev., Lond.*, 8th July 1955, Vol. 157, No. 2, pp. 86–87.) Brief description of new plant for producing the glass components of c.r. tubes.

621.387 **639**

The Current Rise in Gas [-filled] **Triodes and Tetrodes.**—E. Knoop. (*Z. angew. Phys.*, Aug. 1955, Vol. 7, No. 8, pp. 366–371.) An approximate formula is derived for the exponential current rise. The effects of the anode potential, heater voltage, and nature and pressure of the gas are discussed. Experimental results which are in fair agreement with theory, indicate that valves with fast current rise can be produced using hydrogen or an inert gas of higher atomic number (e.g. Xe); the effect of the electrode geometry on the rise time is small.

621.387 : 621.316.722.1 **640**

Glow-Discharge Stabilizers.—F. A. Benson & L. J. Bental. (*Wireless Engr*, Dec. 1955, Vol. 32, No. 12, pp. 330–336.) Measurements have been made to determine the influence of gas filling, gas pressure and direct operating current on the impedance/frequency characteristics of stabilizer tubes over the range 20 c/s–100 kc/s; the tubes had either Ni or Ce-alloy cathodes. The results indicate that for eliminating low-frequency ripple on a rectifier output, tubes with He filling are best; where there is a high-frequency ripple component Ne-filled tubes should be used.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.2 + 538.566 — **641**

On the Focusing Effect of Reflection and Refraction in a Velocity Gradient.—Noble. (See 729.)

534.2 + 538.566 — **642**

Dispersion and Simple Harmonic Point Sources in Wave Ducts.—Tolstoy. (See 730.)

534.2-14 — **643**

Theory of Continuous-Tone [underwater] **Reverberation.**—G. A. Klotzbaugh. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 956–961.)

534.2-14 — **644**

Continuous-Tone Underwater Reverberation.—P. Conley. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 962–966.)

534.23-8 : 546.431.824-31 — **645**

Ultrasonic Shutter.—C. L. Darner & R. J. Bobber. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 908–912.) The transmission of ultrasonic radiation by a $BaTiO_3$ transducer can be controlled by connecting a suitable electrical network to the electrodes. An intensity range of 40 dB can be covered at resonance conditions. The network can be constituted by a carbon microphone, when the ultrasonic beam can be modulated by speech.

534.232 — **646**

Directed Sound.—K. Feik. (*Hochfrequenztech. u. Elektroakust.*, Sept. 1955, Vol. 64, No. 2, pp. 35–62.) Comprehensive analysis is presented leading to the derivation of the radiation characteristics of arrays with linear, ring, spherical, and other arrangements. 40 references.

534.232 : 537.228.1 — **647**

On the Determination of Electromechanical Coupling Coefficients in a Polyresonant Piezoelectric Vibrator.—E. A. G. Shaw. (*Canad. J. Phys.*, Sept. 1955, Vol. 33, No. 9, pp. 504–508.) The well known relation between the electromechanical coupling coefficient and the separation σ of resonance and antiresonance frequencies requires modification where several significant modes occur within a small frequency interval. An approximate expression is given for the values of σ which would arise if each mode existed alone, in terms of the many-moded system.

534.613-8 — **648**

Experimental Studies on Acoustic Radiation Pressure.—E. M. J. Herrey. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 891–896.) Experiments are discussed in which a beam of ultrasonic radiation in water is intercepted by an absorbing or a reflecting disk. Evaluation of the normal and shearing components of the radiation pressure indicates that the latter is properly represented by an anisotropic stress tensor. The technique provides a simple means for measuring the power of a transducer or the reflection, transmission and absorption coefficients of materials. Results of some measurements on cork, Al and steel plates are presented.

534.75 — **649**

Localization of Sound from Single and Paired Sources.—T. T. Sandel, D. C. Teas, W. E. Feddersen & L. A. Jeffress. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 842–852.) Experiments are described in which a listener indicates the direction of (*a*) a single loudspeaker source, (*b*) a pair of phase-aiding loudspeakers, or (*c*) a pair of loudspeakers in phase opposition, by pointing a further loudspeaker in the direction of the source. The loudspeakers to be located emit tone signals alternating with the wide-band noise emitted by the pointer loudspeaker.

534.75 — **650**

Listening to Differentially Filtered Competing Voice Messages.—W. Spieth & J. C. Webster. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 866–871.) Continuation of investigations described previously [2837 of 1954 (Spieth et al.)]. In nearly all cases, differential filtering produced an improvement in the ability of an air-control-tower operator to attend to two messages overlapping in time. Details are given of results for different cut-off frequencies.

534.78 **651**

Vowel Synthesis by means of Resonant Circuits.—E. S. Weibel. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 858–865.) "Various ways of creating artificial vowels are discussed and compared from the viewpoint of coding efficiency. A method which requires seven parameters to specify any vowel is then introduced and described in detail. It is based on the realization of the transfer impedance of a nonuniform transmission line by lumped elements."

534.78 **652**

Phonemic Confusion Vectors.—H. M. Moser & J. J. Dreher. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 874–881.) Experiments are described on the recognition of words used for indicating the letters of the alphabet in telecommunications, with special reference to air-traffic procedure.

534.78 **653**

Auditory Testing of a Simplified Description of Vowel Articulation.—A. S. House & K. N. Stevens. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 882–887.)

534.79 **654**

The Measurement of Loudness.—S. S. Stevens. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 815–829.) Data regarding the relation between subjective loudness and objective sound intensity are reviewed. The evidence suggests that for the typical listener a loudness ratio of 2:1 corresponds to a pair of sound signals differing by 10 dB. At levels below about 50 dB the loudness of white noise grows more rapidly than that of a 1-kc/s tone; above that level the two increase more nearly proportionally.

534.833.1 **655**

New Method of Recording the Sound Transmission Loss of Walls as a Continuous Function of Frequency.—R. V. Waterhouse & R. K. Cook. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 967–969.) Voltages derived from microphones in the 'loud' and 'quiet' rooms separated by the wall under test are applied to a potentiometer recorder which balances itself by driving an attenuator. The difference between the sound levels in the two rooms is nearly identical with the loss in the wall. Results for several types of partition are presented graphically.

621.395.61 + 621.395.623.7 **656**

Limits of Quality of Electroacoustic Transducers.—F. Spandöck. (*Elektrotech. Z., Edn A*, 1st Sept. 1955, Vol. 76, No. 17, pp. 598–604.) The efficiency of transducers is considered; the value for good-quality microphones is about 0·2%, and for loudspeakers about 5%. On the basis of the reciprocity theorem, a general formula is derived for the transmission factor of all reversible transducers; this formula is used to examine the individual importance of the various factors involved. For transducers of known types, no appreciable improvement is to be expected except by development of the magnetic, piezoelectric and mechanical properties of the materials used. 62 references.

621.395.61.089.6 : 534.612 **657**

Reversion to the Theory of the Gold-Leaf Thermophone.—P. Riéty. (*Ann. Télécommun.*, July/Aug. & Sept. 1955, Vol. 10, Nos. 7/8 & 9, pp. 169–178 & 195–201.) The problem of the absolute calibration of microphones is considered. Past work on the thermophone, on which the C.C.I.T. method is based, has left unexplained discrepancies between the calculated and observed values of the acoustic pressure produced. Analysis is given for static and oscillating conditions; the acoustic pressure is calculated from the value of the estimated temperature close to the gold leaf. Formulae derived are compared with those published previously. For early work see, e.g., *Phys. Rev.*, July 1917, Vol. 10, No. 1, pp. 22–38 (Arnold & Crandall).

621.395.623.52 **658**

Analysis of Hypex Horns.—R. I. Ścibor-Marchocki. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 939–946.) Impedance transformations for hyperbolic-function horns [829 of 1946 (Salmon)] are derived using the Smith chart.

621.395.623.7 : 537.523.3 **659**

Corona-Wind Loudspeaker.—D. M. Tombs. (*Nature, Lond.*, 12th Nov. 1955, Vol. 176, No. 4489, p. 923.) Brief note of experimental results obtained using arrays of triodes comprising two point electrodes and an interposed ring electrode which controls the corona wind without requiring a.f. electrical power. The frequency response is good up to 15 kc/s; the radiation pattern is adjustable.

AERIALS AND TRANSMISSION LINES

621.315.212 **660**

Extremely Uniform Wide-Band Cables.—L. Krügel. (*Telefunken Ztg*, June 1955, Vol. 28, No. 108, pp. 107–115. English summary, p. 134.) In order to achieve adequate uniformity in Type-2·6/9·5 cable, the outer conductors are ribbed to prevent deformation, and diamond dies are used for drawing the inner conductors; the spacers are rigid-dielectric disks.

621.315.212 : 621.372.8 **661**

Investigations on a Wide-Band Junction between a Coaxial Line and a Waveguide.—E. Belohoubek. (*Arch. elekt. Übertragung*, Sept. & Oct. 1955, Vol. 9, Nos. 9 & 10, pp. 432–440 & 469–474.) Junctions are discussed of the type in which the inner conductor of the coaxial line serves as an aerial inside the waveguide, the latter being provided with a short-circuiting piston. The dependence of bandwidth on aerial length, the eccentricity of the coupling, the position of the piston and aerial diameter is examined. Bandwidth is greatest for mid-band wavelengths about 1·4 a, where a is the width of the waveguide. A description is given of an arrangement for measuring the bandwidth at different frequencies; bandwidths of 20% are realizable at 10-cm λ, with a reflection coefficient $< 2\%$.

621.372.2 **662**

Reflection in Helical Lines at a Change in the Helix Pitch: Part 2—Mathematical Treatment of the Problem.—G. Piefke. (*Arch. elekt. Übertragung*, Sept. 1955, Vol. 9, No. 9, pp. 402–410.) Part 1: 322 of February.

621.372.2.029.64 : 538.6 **663**

Application of Electron Plasma in the Production of Nonreciprocal Systems.—A. L. Mikaelyan. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, July 1955, No. 7, pp. 23–33. In Russian.) A study of the propagation of e.m. waves between parallel planes or in a coaxial line containing a layer of electron plasma in a steady magnetic field. Nonreciprocal systems for TEM waves are discussed generally; a brief note suggests that an artificial dielectric could be used in place of the plasma or ferrite;

the Hall effect would then be made use of, and no resonance effects would occur in the medium. A similar account is given in *C. R. Acad. Sci. U.R.S.S.*, 1st & 11th Sept. 1955, Vol. 104, No. 1, pp. 72–75 & No. 2, pp. 233–236, also in Russian.

621.372.22 : 621.372.51 **664**

Nonuniform Transmission Lines as Impedance-Matching Sections.—J. Willis & N. K. Sinha. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, p. 1975.) Design analysis is given for lines having better matching properties than the parabolic line described by Yang (3148 of 1955).

621.372.8 **665**

Degenerate Oscillations in Waveguides.—B. Z. Katsenelenbaum. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, July 1955, No. 7, pp. 9–22. In Russian.) The perturbation of oscillations in a waveguide due to slight deformations in the walls is considered theoretically.

621.372.8 **666**

Dielectric Transformers for X-Band Waveguide.—I. D. Olin. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 146–147.) Teflon sections are described for (*a*) matching circular to rectangular waveguide, and (*b*) providing a pressure seal for circular waveguide.

621.372.8 : 621.318.134 **667**

Magnetically Controlled Microwave Directional Coupler.—R. W. Damon. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1281–1282.) The coupling effected by a Ni-Zn ferrite cylinder linking two stacked rectangular waveguides is controlled by changes in the sense and magnitude of an applied magnetic field parallel to the electric vector. The coupling in dB is shown plotted against the magnetic field for a typical device operating at 8·4 kMc/s.

621.396.67 : 621.317.3 **668**

Measurements on Receiving Aerials : Part 2.—I. Grosskopf. (*Arch. tech. Messen*, Sept. 1955, No. 236, pp. 195–196.) Part 1 : 3492 of 1955.

AUTOMATIC COMPUTERS

681.142 **669**

On Starting Routines for the C.S.I.R.O. Mark I Computer.—G. W. Hill & T. Pearcey. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 412–416.) This computer was noted in 640 and 641 of 1954 (Pearcey & Hill).

681.142 **670**

An Assessment of the System of Optimum Coding used on the Pilot Automatic Computing Engine at the National Physical Laboratory.—J. H. Wilkinson. (*Phil. Trans. A*, 20th Oct. 1955, Vol. 248, No. 946, pp. 253–281.) Simple examples are given of programs prepared for the pilot ACE, and an assessment is made of the gain in speed resulting from the use of optimum coding in general. The design of the full-scale ACE is described.

681.142 **671**

A Criterion for the Operational Stability of Analogue Mathematical Machines.—M. Parodi. (*C. R. Acad. Sci., Paris*, 24th Oct. 1955, Vol. 241, No. 17, pp. 1104–1105.)

681.142 : 512.831 **672**

Matrices in Analogue Mathematical Machines.—P. M. Honnell & R. E. Horn. (*J. Franklin Inst.*, Sept. 1955, Vol. 260, No. 3, pp. 193–207.) Discussion indicates the usefulness of matrix methods for solving linear differential equations by means of electronic analogue machines.

681.142 : 621.372 **673**

The use of Electronic Analogue Computers with Resistance Network Analogues.—W. J. Karplus. (*Brit. J. appl. Phys.*, Oct. 1955, Vol. 6, No. 10, pp. 356–357.) In the solution of partial differential equations by resistance-network analogues the appropriate voltage required at the nodes of the network may be provided automatically by connecting standard electronic-analogue-computer units to each node. This procedure combines the speed of the computer method of solution with the inherent accuracy of the resistance-network analogue.

681.142 + 621.318.5](47) : 016 **674**

List of Russian and Translated Literature on the Theory of Relay-Contact [switching] **Circuits for 1950–1954.**—Povarov. (See 680.)

681.142 : 517 **675**

Approximations for Digital Computers. [Book Review]—C. Hastings, Jr. Publishers: Princeton Univ. Press, Princeton, N.J., 1955, 201 pp., $4. (*Science*, 30th Sept. 1955, Vol. 122, No. 3170, p. 602.) The adaptation of special functions for purposes of machine computing is described and illustrated; Tchebycheff approximations are used.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.012 : 537.312.6 **676**

The A.C. Admittance of Temperature-Dependent Circuit Elements.—R. E. Burgess. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 766–774.) The general relations between the isothermal and steady-state I/V characteristics of a temperature-dependent device are deduced. Analysis is presented for the small-signal admittance in terms of the thermal admittance. The reactive components due to the thermal inertia and the turnover characteristics exhibited when the a.c. resistance is negative are examined with reference to equivalent circuits. Where heat loss from the device is by a path which is not 'thermally short', the thermal admittance is determined from the diffusion equation. This is done for the case of one-dimensional conduction along the supporting wires of a thermistor or lamp, and for the case of radial conduction from the contact in a point-contact rectifier.

621.314.2 : 621.375.227.029.3 **677**

UL ['ultralinear'] **Output Transformers.**—D. M. Leakey & R. B. Gilson. (*Wireless World*, Jan. 1956, Vol. 62, No. 1, pp. 29–32.) Factors affecting the stability, particularly at high frequencies, of 'ultralinear' push-pull output stages are discussed and a practical circuit is described. Avoidance of cross-coupling between the push-pull valves and correct design of the output transformer, details of which are presented, will usually ensure stability without additional circuitry.

621.316.825 : 621.3.011.21 **678**

Impedance of a Thermistor at Low Frequencies.—F. J. Hyde. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 303–313.) The small-signal impedance of a directly heated thermistor has been measured at frequencies between 0·116 and 2·34 c/s, and the effective circuit time-constant of the same thermistor has been measured as a function of the magnitude of an external series resistance. Assuming the cooling process is Newtonian, the results are in accord with the equivalent circuit proposed by Burgess (676 above).

621.318.5 : 621.318.134 **679**

New Type Ferrite Microwave Switch.—R. F. Sullivan & R. C. LeCraw. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1282–1283.) Discussion of a switch comprising a ferrite rod arranged axially in a cylindrical cavity fed and terminated by rectangular waveguides. When a longitudinal magnetic field is applied the cavity is detuned for certain modes and the plane of polarization is rotated; the output waveguide acts as a polarization filter. Good isolation is obtained over a wide range of magnetic-field values. Advantages over the rotation-type switch are indicated.

621.318.5 + 681.142](47) : 016 **680**

List of Russian and Translated Literature on the Theory of Relay-Contact [switching] **Circuits for 1950–1954.**—G. N. Povarov. (*Avtomatika i Telemekhanika*, July/Aug. 1955, Vol. 16, No. 4, pp. 411–420 and correction sheet.) A bibliography on computers is included.

621.318.57 : 621.383.4 : 535.37 **681**

Opto-electronic Devices and Networks.—Loebner. (See 931.)

621.372 : 512.8/.9 **682**

Tensor Analysis and Linear Network Theory.—R. Braae. (*Trans. S. Afr. Inst. elect. Engrs*, Aug. 1955, Vol. 46, Part 8, pp. 233–239.) Discussion on 2553 of 1955.

621.372 : 512.9 **683**

Examination of the 'Negative Frequency' Concept.—A. P. Bolle & J. L. Bordewijk. (*J. Brit. Instn Radio Engrs*, Nov. 1955, Vol. 15, No. 11, pp. 582–587. Reprinted from *PTT Bedrijf*, Oct. 1954, Vol. 6, No. 2.) Circuit-operation analysis is simplified by considering the angular velocity of the vectors representing signals as a combination of a positive and a negative velocity. Applications include the study of time-variable networks, intermodulation noise, Fourier series and the Fourier integral.

621.372.4.011.1 **684**

Derivation of Two-Pole Function with Prescribed Complex Values within a Partial Range of Real Frequencies.—W. Krägeloh. (*Arch. elekt. Übertragung*, Aug.–Oct. 1955, Vol. 9, Nos. 8–10, pp. 375–380, 419–431 & 479–483.) Two solutions are presented in detail for the problem of deriving a two-pole (positive) function which is a satisfactory approximation to a complex function prescribed graphically.

621.372.413 **685**

Cavity Resonators with Non-orthogonal Boundaries.—E. Ledinegg & P. Urban. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 335–350.) Analysis based on the particular-integral method described by Hahn (1336 of 1941) is presented for resonators of arbitrary cylindrical form.

621.372.413 **686**

On Representation of Electromagnetic Fields in Cavities in Terms of Natural Modes of Oscillation.—S. A. Schelkunoff. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1231–1234.) Statements made by Teichmann & Wigner (2268 of 1953) are discussed. The assumption that when a cavity is short-circuited one mode is automatically suppressed is shown to be incorrect.

621.372.45 **687**

Circuits with Nonlinear Resistance.—A. Liebetegger. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, pp. 24–29.) Analysis is presented for circuits comprising a diode in series with linear impedances which may consist of R, L, C, or a combination of these.

621.372.5 **688**

Transformation Rules for Noisy Quadripoles.—W. Dahlke. (*Arch. elekt. Übertragung*, Sept. 1955, Vol. 9, No. 9, pp. 391–401.) Experimental determination of the noise parameters [2568 of 1955 (Rothe & Dahlke)] becomes difficult at h.f. because of lead reactances; formulae for the transformations thus introduced are derived and tabulated.

621.372.5 **689**

Transient Response Calculation.—O. P. D. Cutteridge. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, pp. 29–30.) Advantages of the method using standard gain/frequency curves over the linear-segment method described by Sarma (2559 of 1955) are indicated.

621.372.5 : 621–526 **690**

The Response Functions and Vector Loci of First and Second Order Systems.—D. Morris. (*Electronic Engng*, Sept.–Dec. 1955, Vol. 27, Nos. 331–334, pp. 402–404, 442–444, 499–501 & 546–548.) Techniques for applying Nyquist's stability criterion to determine the behaviour of automatic control systems operating according to equations of the first degree in frequency are summarized; constructions are given for determining the vector loci of the functions relating performance and frequency. Second-order low-Q systems having a circular vector response locus, giving symmetrical resonance curves, are discussed and the theory of the bandwidth method for determining Q is deduced. Passive and active second-order systems are considered which have finite response at zero frequency and an antiphase or a quadrature zero-limit at infinite frequency, with 'cordiform' vector loci. All second-order response loci may be expressed in terms of two basic loci.

621.372.5 : 621.396.822 **691**

The Noise Factor of Four-Terminal Networks.—A. G. T. Becking, H. Groendijk & K. S. Knol. (*Philips Res. Rep.*, Oct. 1955, Vol. 10, No. 5, pp. 349–357.) A simple formula is derived on the basis that the noise properties of the network can be characterized by two noise sources introduced at the input; these sources and their correlation are determined by four quantities which can be evaluated from measurements.

621.372.5.024 : 621.387 **692**

A D.C.-Coupled Circuit using Voltage-Stabilizing Valves.—G. W. G. Court. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 549–550.) Voltage-stabilizing valves connected in series are used to transfer d.c. voltage variations from an initial reference level of +150 V to a level of −450 V, providing the reflector potential of a klystron oscillator.

621.372.543.2 **693**

Staggered Triple Crystal Filter.—D. E. Hildreth. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 166–167.) Narrow-band filters with very sharp cut-off characteristics are more simply obtained with piezoelectric crystals than by the usual lattice construction over the frequency range 400 kc/s–5 Mc/s. A typical filter has a bandwidth of 400 c/s at 3 dB attenuation and 800 c/s at 40 dB attenuation, centred on 400 kc/s.

621.372.56.027.7 **694**

Compensated Precision High-Voltage Attenuator.—J. G. Cottingham. (*Rev. sci. Instrum.*, Sept. 1955, Vol. 26, No. 9, pp. 876–877.) The frequency response of a voltage divider consisting of twelve 2·5-MΩ units enclosed by metal corona shields is made linear up to 200 kc/s by connecting capacitances between the shields and the high-voltage source, thus compensating for the capacitance to ground.

621.372.57 : 621.316.721 **695**

Some High-Impedance Current-Generating Circuits.—J. H. McGuire. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 529–531.) A basic circuit is described and practical designs are developed for the efficient generation of current waveforms which are independent of the load impedance.

621.373 : [621.314.632 + 621.316.825 **696**

Electrical Oscillations in Thermistors and Germanium Point-Contact Rectifiers.—R. E. Burgess. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 297–302.) The conditions for small-amplitude oscillations in nonlinear temperature-dependent circuit elements are deduced analytically and discussed in relation to thermistors and Ge point-contact rectifiers, whose impedance comprises inductive reactance in series with a resistance which can be made negative, so that these devices can sustain oscillations when shunted with a suitable capacitance. The upper limiting frequency and the dependence of frequency on the shunt capacitance are deduced in terms of the fundamental parameters. Departures from the postulated model which can arise with the point-contact rectifier are discussed.

621.373.421 **697**

Constant-Frequency Oscillators.—A. S. Gladwin. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, pp. 13–19.) "The conditions for the frequency of a regenerative oscillator to be independent of changes in the input and output resistances of the maintaining amplifier are derived. It is shown that the input, output, and transfer impedances of the feedback network must be resistive at the oscillation frequency. This can be achieved by inserting reactances of definite specified values in the input and output leads. Expressions for the value of these reactances are derived for the usual type of *LC* oscillator with mutual-inductance coupling. The values depend greatly on whether the losses in the coils can be represented mainly by a series or by a parallel resistance. Expressions for the stability of an imperfectly-stabilized oscillator are also derived. The results are compared with those obtained by Llewellyn. It is shown that the values of stabilizing reactances specified by Llewellyn are not in general satisfactory, though in some instances they may produce a marked improvement in stability. Full experimental confirmation is given."

621.373.43 **698**

A Sufficiently Fast and Economical Sweep Circuit.—D. Brini, L. Peli, O. Rimondi & P. Veronesi. (*Nuovo Cim.*, 1st Sept. 1955, Vol. 2, No. 3, pp. 644–646. In English.) A circuit giving sweep times from 40 mμs to 3 μs is based on a design described by Moody et al. (2730 of 1952) using secondary-emission valves.

621.375.2.029.3 : 621.396.712.2 **699**

Peak-Limiting Amplifiers.—R. Yadav. (*J. Instn Telecommun. Engrs, India*, Sept. 1955, Vol. 1, No. 3, pp. 147–154.) A description is given of a circuit designed by All India Radio; the steps taken to reduce the attack time to <16 μs are indicated. The control range above threshold is 15 dB and the compression ratio is 10:1.

621.375.221.029.63 **700**

Wide-Band Amplifier for U.H.F. Receivers.—R. B. McWhirt. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 158–160.) A detailed design is given for an amplifier using a Type-416B planar triode, providing 5–10 dB gain, with a bandwidth > 200 Mc/s centred on 1·1 kMc/s.

621.375.23.029.3 **701**

Tetrodes with Screen Feedback.—(*Wireless World*, Jan. 1956, Vol. 62, No. 1, pp. 24–26.) The operation of the 'ultralinear' a.f. amplifier [1512 of 1952 (Hafler & Keroes)] is discussed; the advantage is that triode performance as regards low inherent distortion is combined with power efficiency approaching that of a pentode.

621.375.4 : 621.314.7 **702**

Some Properties and Circuit Applications of Super-Alpha Composite Transistors.—Pearlman. (See 927.)

621.375.4 : 621.314.7 **703**

Bases for the Calculation of Transistor Amplifiers with Series and Parallel Feedback.—W. Benz. (*Telefunken Ztg*, June 1955, Vol. 28, No. 108, pp. 95–107. English summary, pp. 133–134.) The various possible arrangements are classified and discussed in terms of network theory. Relevant definitions, inter-relations, equivalent circuits and formulae are set out in ten tables.

621.375.4 : 621.314.7 **704**

The Equations and the Equivalent Circuit of the Transistor.—Skalicky. (See 928.)

621.375.4 : 621.314.7 **705**

Germanium Transistor Amplifiers Stable to 95°C.—W. Greatbatch & W. Hirtreiter. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, p. 1974.) Though transistors are available whose current gain does not change greatly on heating up to 100°C, the operating point of the corresponding amplifier circuit may shift appreciably at far lower temperatures. In a particular circuit using two transistors the operating point can be stabilized by including a parallel-*RLC* network in a feedback loop. Si units can be stabilized at temperatures above 100°C.

GENERAL PHYSICS

53.088.3 **706**

Correcting for Running Means by Successive Substitutions.—R. N. Bracewell. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 329–334.) The proposed procedure leads to a divergent result but is nevertheless useful in many practical cases.

530.145.6 : 621.385.833 **707**

Wave Mechanics Theory of Electron-Optical Image Formation: Part 2.—W. Glaser & G. Braun. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 267–296.) Part 1 : 2253 of 1955.

534.372 **708**

Connection between the Logarithmic Decrement of Attenuation and the Fractional Attenuation of the Amplitude of Potential Energy (Cyclical Viscosity).—D. I. Shil'krut. (*C. R. Acad. Sci. U.R.S.S.*, 11th Sept. 1955, Vol. 104, No. 2, pp. 237–238. In Russian.) Earlier experimental evidence on torsional and other oscillations suggests that the logarithmic decrement, δ, is time-dependent. It may be expressed by the formula

$2\delta = \Delta a/a - \Delta c/c$, where a is the total energy of oscillation, Δa the energy loss per cycle, c the potential energy for unit amplitude and Δc the change in c per cycle; c is a function of time.

535.376 **709**

Reinforcement of the Electroluminescence of Certain Crystals by Rotation in the Field.—G. Destriau. (*C. R. Acad. Sci., Paris*, 3rd Oct. 1955, Vol. 241, No. 14, pp. 869–870.) When electroluminescent crystals are embedded in a dielectric and not in contact with the field electrodes, luminescence is normally observed only in alternating fields, though it can be produced in direct fields by rotating the crystals. Experimental evidence is now reported that the luminescence in an alternating field is enhanced by rotating the crystals. Long-term falling off of electroluminescence may be partly due to surface effects at the crystal/dielectric boundary, these effects being eliminated when the crystals are continually displaced.

535.41 : 535.215 **710**

Photoelectric Mixing of Incoherent Light.—A. T. Forrester, R. A. Gudmundsen & P. O. Johnson. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1691–1700.) Experiments are described in which beats were obtained between incoherent light sources by mixing Zeeman components of a visible spectral line at a photoemissive surface. A 3-cm-λ cavity-resonator arrangement was used for detection. The results are consistent with the view that the photoelectric emission probability is proportional to the square of the resultant electric-field amplitude, implying interference between light from independent sources. The results also indicate that any time delay between photon absorption and electron emission must be significantly less than 10^{-10} sec.

537.311.62 **711**

Effect of Collisions between Electrons on Electrical Conductivity and Skin Effect in Metals.—V. L. Ginzburg & V. P. Silin. (*Zh. eksp. teor. Fiz.*, July 1955, Vol. 29, No. 1 (7), pp. 64–74.) Theoretical considerations indicate that the results of the theory of the anomalous skin effect are not greatly affected by taking electron collisions into account. The work on the anomalous skin effect and the reflectivity of metals by Benthem & Kronig (3523 of 1954) is criticized.

537.322.3 **712**

Measurements of the 3rd-Order Thermoelectric Single-Material Effect (1st Benedicks Effect).—G. Kocher. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 210–226.) The coefficient c_3 in the formula $u = c_3 \cdot \Delta t^3$, where u is the e.m.f. and Δt is the temperature difference, was determined experimentally using small rectangular loops of Pt, Au, and Ag, heated and cooled at two diametrically opposite points. For a loop of dimensions 38 × 58 mm made of material with cross-section 4 mm², the value of c_3 was about $-2{\cdot}7 \times 10^{-14}$ V/deg³ for Pt, $-4{\cdot}6 \times 10^{-15}$ for Au, and $-2{\cdot}6 \times 10^{-15}$ for Ag.

537.322.3 **713**

Remarks on the 1st Benedicks Effect.—W. Meissner. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 227–228.) Comments on paper by Kocher (712 above). The coefficient c_3 may be a function of Δx, the distance between the two points with temperature difference Δt; this is of importance when Δx is smaller than the mean free path of the conduction electrons.

537.5 **714**

Traveling Density Waves in Positive Columns.—S. Watanabe & N. L. Oleson. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1701–1704.) "The continuity equations for positive ions and for electrons coupled to each other by the Coulomb force and the effect of ionizing collisions have a solution representing traveling density waves whose frequencies are widely different from the usual plasma oscillations."

537.52 : 538.56 **715**

Amplification of 1-cm Waves in the Helium Negative Glow.—Z. Geller & W. Low. (*Nature, Lond.*, 26th Nov. 1955, Vol. 176, No. 4491, pp. 1021–1022.) A detailed examination was made of the attenuation of 1·25-cm-λ waves in an abnormal discharge in He at a pressure of 1–3 mm Hg, by directing a beam from a klystron at right angles to the discharge and detecting the radiation transmitted. A graph shows attenuation as a function of distance from the discharge-tube cathode for given discharge conditions. Negative attenuation values are observed at distances around 13 mm; the electron density in this region is estimated to be about 7×10^{12}/cm³. The amplification may be due to plasma oscillations; a secondary dip in the attenuation curve may be due to a harmonic.

537.525 : 621.3.029.53/.55 **716**

Influence of a Transverse Magnetic Field on the Breakdown Voltage of a Gas Discharge at High Frequency.—L. Ferretti & P. Veronesi. (*Nuovo Cim.*, 1st Sept. 1955, Vol. 2, No. 3, pp. 639–643.) Measurements were made on tubes with cylindrical electrodes containing air at pressures of 0·1, 0·5 and 1 mm Hg, at frequencies from 10 to 50 Mc/s, with magnetic fields of strength 0–650 G. Results are presented graphically and discussed in relation to those of Herlin & Brown (3390 of 1948).

537.533 : 537.311.33 **717**

Field Emission from Semiconductors.—R. Stratton. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 746–757.) Theory is presented derived from that developed by Fowler & Nordheim for field emission from metals (*Proc. roy. Soc. A*, 1st May 1928, Vol. 119, No. 781, pp. 173–181). If there are an appreciable number of surface states, the emission current is very low until the field is strong enough to break down the internal barriers. When this occurs, or if there are no surface states, the field penetrates into the semiconductor, lowering the conduction-band edge. This causes degeneracy near the surface and greatly enhanced emission. Emission associated with surface states is temperature dependent while emission associated with field penetration is not.

537.533 : 621.385.83 **718**

Relation between an Arbitrary Field $\vec{B}(r, \phi, z)$ and the Field of Revolution $\vec{B}^R(r, z)$ such that $B^R{}_z(0, z) = B_z(0, z)$. Applications.—P. Gautier. (*C. R. Acad. Sci., Paris*, 10th Oct. 1955, Vol. 241, No. 15, pp. 930–932.) Electron-optical analysis using cylindrical coordinates leads to a theorem on the measurement of an arbitrary magnetic field by means of search coils with rotational symmetry.

537.533.74 : [546.74 + 546.77 **719**

Inelastic Scattering of Electrons by Ni and Mo Targets.—A. R. Shul'man & I. I. Farbshtein. (*C. R. Acad. Sci. U.R.S.S.*, 1st Sept. 1955, Vol. 104, No. 1, pp. 56–59. In Russian.) An experimental investigation is briefly reported. Energy-loss peaks for electrons

inelastically scattered by Mo were observed at 5·5, 11·6 and 17 ± 0·8 V and these values were independent of the energy of the incident electrons in the range from 40 to 120 eV. In scattering by Ni the peak occurred at 12·5 ± 0·5 V. The results for the Mo target agree to within 11% with the values calculated for molybdenum oxide, and evidence that such a film was probably present in spite of precautions was also obtained from secondary-emission measurements.

537.533.8 **720**

Theory of Secondary Electron Emission from Solids.—H. Fröhlich. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 657–660.) In the derivation of a formula permitting the calculation of the yield of secondary electrons from the yield of photoelectrons, the primary particle is replaced by a moving point charge. The electric displacement is developed in a Fourier series in time and to each frequency a photoelectron yield is ascribed.

537.56 : 538.56 **721**

Eigen Oscillations of Compressible, Ionized Fluids.—R. E. Loughhead. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 416–418.) The frequencies of eigen-oscillations are derived from the hydromagnetic equations for a compressible fluid of infinite electrical conductivity for uniform-magnetic-field regions bounded by cylindrical and plane-parallel surfaces.

537.56 : 538.6 **722**

Hydromagnetic Stability of a Current Layer.—R. E. Loughhead. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 319–328.) "The hydromagnetic stability of a uniform current flowing along a magnetic field and confined within a pair of parallel planes is discussed by the method of normal modes. The condition for marginal stability is derived and discussed with reference to two special cases. It is also shown that the velocity of Alfvén waves along a magnetic field in a region bounded by parallel planes is reduced due to the inertia of the surrounding medium."

537.56 : 538.6 **723**

Solution of Problems involving the Hydromagnetic Flow of Compressible Ionized Fluids.—R. E. Loughhead. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1678–1681.) "The characteristic forms of the hydromagnetic equations for a compressible fluid are examined from the viewpoint of obtaining by the method of finite differences numerical solutions for continuous initial value problems involving unidimensional motion of the fluid."

537.562 : [537.29 + 538.69 **724**

Velocity-Distribution Function of Electrons in Alternating Electric and Constant Magnetic Fields.—A. V. Gurevich. (*C. R. Acad. Sci. U.R.S.S.*, 11th Sept. 1955, Vol. 104, No. 2, pp. 201–204. In Russian.) A calculation similar to that of Jancel & Kahan (1995 of 1953) on the e.m. effects in the ionosphere is presented and some errors in that paper are indicated. Using the calculated velocity distribution, the mean electron energy and the plasma conductivity are calculated.

538 : 536.48 **725**

Conference on Low-Temperature Magnetism: Kharkov, 1st–3rd July 1954.—(See 822.)

538.11 **726**

The Spin-Wave Theory of Antiferromagnetism.—W. Marshall. (*Proc. roy. Soc. A*, 11th Oct. 1955, Vol. 232, No. 1188, pp. 69–77.) Following a discussion of antiferromagnetism (*ibid.*, pp. 48–68) with particular reference to the calculations of Kubo (*Rev. mod. Phys.*, Jan. 1953, Vol. 25, No. 1, pp. 344–351), various criticisms of the spin-wave theory are considered; conclusions drawn from this theory, particularly as to the conditions required for antiferromagnetism, are not to be relied upon.

538.114 **727**

Quantum Theory of Ferromagnetism.—S. V. Vonsovski, K. B. Vlasov & E. A. Turov. (*Zh. eksp. teor. Fiz.*, July 1955, Vol. 29, No. 1 (7), pp. 37–50.)

538.24 **728**

Dependence of Magnetic Viscosity on Dimensions of Specimens.—A. N. Remizov. (*C. R. Acad. Sci., U.R.S.S.*, 21st Sept. 1955, Vol. 104, No. 3, pp. 389–390. In Russian.) Results are presented graphically of an experimental investigation on cylindrical armco specimens of lengths up to 50 cm and diameters up to 10 mm.

538.566 + 534.2 **729**

On the Focusing Effect of Reflection and Refraction in a Velocity Gradient.—W. J. Noble. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 888–891.) Analysis based on geometrical optics is presented for wave propagation in a stratified medium. Divergence factors are tabulated for four different system configurations.

538.566 + 534.2 **730**

Dispersion and Simple Harmonic Point Sources in Wave Ducts.—I. Tolstoy. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 897–907.) Analysis is presented for wave propagation in stratified media. An exact solution is obtained for the general case of waves from a point source in a duct by introducing an integral solution due to Brekhovskikh (1394 of 1950).

538.566 : 537.56 **731**

Theory of Propagation of Plane Waves in Homogeneous Plasma.—G. Winkler. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 414–428.) The theory combines the macroscopic-phenomenological and microscopic-statistical approaches. Assumptions made include: (*a*) that charge-carrier velocity is very much smaller than the velocity of light; (*b*) that the plasma is homogeneous and stationary; (*c*) that the amplitudes of disturbances due to the wave propagation are small; (*d*) that collisions between charge carriers and neutral particles are inelastic; and (*e*) that the electric and magnetic moments of neutral molecules and of ions and the magnetic moments of free electrons may be neglected.

538.566 : 538.6 : 537.56 **732**

Investigation of the Faraday Effect in a Plasma at 10 kMc/s.—M. Bonnet, M. Matricon & E. Roubine. (*Ann. Télécommun.*, July/Aug. 1955, Vol. 10, Nos. 7/8, pp. 150–158.) Experimental and theoretical investigations are reported. An arrangement comprising a circular waveguide containing a pulsed neon tube was used to demonstrate rotation of the plane of polarization; the magnetic field obtainable in the experimental arrangement was not strong enough to produce gyromagnetic resonance at the frequency used. Analysis based on bicomplex numbers is presented for propagation in an ionized medium in a magnetic field.

538.566.2/.3 : 537.56 : 538.6 **733**

The Four Possible Waves in a Magneto-ionic Medium.—J. H. Piddington. (*Phil. Mag.*, Oct. 1955, Vol. 46, No. 381, pp. 1037–1050.) The theory presented shows that a magneto-ionic medium composed mainly

of electrons and heavy ions is quadruply refracting, transmitting four, and only four, different waves. The hydromagnetic ordinary and extraordinary waves are identical with the radio O and E waves, the latter being the limiting case of the former for frequencies at which the motion of the heavy ions is negligible. The other two waves comprise a 'magnetic sound' wave (a type of hydromagnetic wave) and a 'magnetic plasma' (P) wave. The P wave is discussed using transport equations and an explanation is given of non-thermal solar radio noise. The effect of electron pressure on the O and E waves is determined quantitatively. A short account of the work is given in *Nature, Lond.*, 5th Nov. 1955, Vol. 176, No. 4488, pp. 875–876. See also 91 of January and back references.

538.569.4 : 535.34 : 546.21 **734**

Microwave Absorption in Compressed Oxygen.—A. A. Maryott & G. Birnbaum. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, p. 1886.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **735**

Galactic Survey at 400 Mc/s between Declinations −17° and −49°.—R. X. McGee, O. B. Slee & G. J. Stanley. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 347–367.) The survey was carried out using an aerial with beam width of 2° between half-power points. Results are tabulated and contour diagrams of equivalent sky temperature are given. The method of calibrating the equipment in terms of temperature is described.

523.16 : 538.561 **736**

The Observation and Interpretation of Radio Emission from some Bright Galaxies.—B. Y. Mills. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 368–389.) Observations are reported of eight southern galaxies in the magnitude range 7 to 11, the Magellanic Clouds, and the Milky Way in the region of the galactic centre. A radiotelescope operating at 3·5-m λ was used. The results obtained tend to support the ideas of Shklovski (*Astr. J., Moscow*, 1952, Vol. 29, p. 418 & 1953, Vol. 30, p. 15) according to which the galactic emission comprises two subsystems, one showing a discoidal distribution highly concentrated towards the galactic plane, the other a very dispersed and approximately spherical distribution centred on the galactic centre. Contrary to Shklovski's interpretation, the contribution of thermal emission from ionized hydrogen to the discoidal distribution is likely to be small.

523.2 : 538.12 **737**

The Magnetic Field in the Vicinity of the Solar System.—W. I. Kraushaar. (*Progr. theor. Phys.*, July 1955, Vol. 14, No. 1, p. 77.) A brief discussion of the significance for particle trajectories of the assumption of the existence of an approximately uniform magnetic field in the vicinity of the solar system. See also *ibid.*, pp. 78–79.

523.5 : 621.396.11 **738**

Diurnal Variations in the Number of Shower Meteors detected by the Forward-Scattering of Radio Waves: Part I—Theory.—C. O. Hines. (*Canad. J. Phys.*, Sept. 1955, Vol. 33, No. 9, pp. 493–503.) System factors affecting the observations are combined to provide a weighting factor varying in correspondence with the diurnal variation of the shower-radiant position, so that the effect of this variation can be distinguished from that of random changes in the incidence rate of the meteors.

523.53 : 621.396.96 **739**

The Radar Determination of Meteor Showers in the Southern Hemisphere.—C. D. Ellyett & K. W. Roth. (*Aust. J. Phys.*, Sept. 1955, Vol. 8, No. 3, pp. 390–401.) A report is presented of observations made during 1953, at a frequency of 69 Mc/s, using radar pulses of peak power 75 kW, duration 3·5 μs and recurrence rate 145/sec.

523.72 : 538.56.029.6 **740**

Three-Millimeter Wave Radiation from the Sun.—W. Gordy, S. J. Ditto, J. H. Wyman & R. S. Anderson. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, p. 1905.) Radiation of wavelength 3·2 mm has been received with a signal/noise ratio of about 25. Typical records obtained with movable and fixed aerials are reproduced.

523.72 : 621.396.822 **741**

A Method of discriminating Disturbances in V.H.F. Solar Noise Observation.—K. Kawakami, T. Takahashi & M. Onoue. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 111–123.) Continuous records are made of the total noise signal received at 200 Mc/s and of the signal after passage through a waveform discriminator which separates out the atmospheric and man-made noise. Solar noise, being random in character, appears only on the first record.

523.78 : 551.510.535 **742**

Solar Eclipses and the Ionosphere.—W. J. G. Beynon. (*Nature, Lond.*, 19th Nov. 1955, Vol. 176, No. 4490, pp. 947–948.) Report of a symposium held in London in August 1955.

550.372 **743**

The Electrical Conductivity of the Earth's Mantle.—S. K. Runcorn. (*Trans. Amer. geophys. Union*, April 1955, Vol. 36, No. 2, pp. 191–198.)

550.385 : 551.593 **744**

Changes in Brightness, Polarization, and Colour of the Zenith Day Sky accompanying Geomagnetic Activity.—D. R. Barber. (*J. atmos. terr. Phys.*, Sept. 1955, Vol. 7, No. 3, pp. 170–172.) Observed effects are attributed to variations in the size of the particles causing the magnetic disturbance.

551.510.5 **745**

The Molecular Diffusive Rate of Change of Composition in the Atmosphere.—S. Chapman. (*J. Met.*, April 1955, Vol. 12, No. 2, pp. 111–116.) Calculations are made for an atmosphere uniformly mixed, for heights up to 80 km.

551.510.5 : 621.396.96 **746**

Resolution in Height of a Radar Pulse.—Miles. (See 764.)

551.510.53 **747**

The Aeronomic Problem of Nitrogen Oxides.—M. Nicolet. (*J. atmos. terr. Phys.*, Sept. 1955, Vol. 7, No. 3, pp. 152–169.) The concentration of nitric oxide in the upper atmosphere is calculated for various heights; its vertical distribution follows that of the atmosphere. Maximum production occurs in the E layer; diffusion and atmospheric mixing can provide an explanation of the ionization of the D layer.

551.510.534 **748**

New Experimental and Theoretical Investigations on the Atmospheric Ozone Layer.—H. K. Paetzold. (*J. atmos. terr. Phys.*, Sept. 1955, Vol. 7, No. 3, pp. 128–140.) For altitudes from 24 km to 60 km the ozone distribution determined experimentally is in

satisfactory agreement with theory; below 24 km the predicted values of ozone content are higher than the measured values. Further world-wide measurements are required and an ozone radiosonde apparatus is being developed for the purpose.

551.510.535 **749**

Chapman Theory of Photo-ionization for a Nonisothermal Atmosphere.—F. Mariani. (*Ann. Geofis.*, Jan. 1955, Vol. 8, No. 1, pp. 59–73.) The atmospheric temperature is assumed to vary linearly up to a certain height, beyond which it is constant. Analysis indicates that the assumption of a plane earth makes no appreciable difference to the value found for the ionization density, at least for zenith angles $< 60°$. The ionization distribution and the height of maximum ionization are appreciably different from the values given by Chapman's original theory.

551.510.535 **750**

Critical Considerations on the Ionosphere F Layer.—P. Dominici & F. Mariani. (*Ann. Geofis.*, Jan. 1955, Vol. 8, No. 1, pp. 103–120.) From general considerations of the layer-formation processes, observed anomalies are found to be associated with the F_2 layer. They cannot be explained by thermal expansion alone, but can be explained by the dynamo theory. Superposition of the F_1 and true F_2 layers can account for some anomalies, but calculations depend on the correct estimation of the virtual height of the F_2 layer. The importance of the temperature/height distribution is indicated in relation to the hypothesis that the whole of the F layer is formed by the same ionization process. To reduce experimental $h'(f)$ curves to $N(z)$ curves it is necessary to use numerical methods not based on a priori models.

551.510.535 **751**

On the Influence of Electron-Ion Diffusion on the Electron Density and Height of the Nocturnal F_2 Layer.—T. Yonezawa. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 125–136.) Analysis indicates that electron-ion diffusion will not change the distribution in a Chapman layer, but will cause a fall in the height of maximum density. Since the height of the F_2 layer does not change measurably after sunset, this suggests a lower limit to the molecular density in the F_2 region, considered as a Chapman layer, of 5×10^8 cm^{-3}.

551.510.535 **752**

Distortion of the E Layer of the Ionosphere by Electrical Currents flowing in it.—E. Appleton, A. J. Lyon & A. G. Turnbull. (*Nature, Lond.*, 12th Nov. 1955, Vol. 176, No. 4489, pp. 897–899.) The divergence of actual ionospheric conditions from conditions corresponding to an ideal Chapman layer is investigated in the light of the asymmetrical diurnal variation of E-layer properties and its dependence on latitude. The evidence indicates that the apparent values of recombination factor are affected by a factor depending on electron transport, and that the S_q current system exerts a marked influence on the maximum value N_m of ionization in the E layer and on the height at which the maximum occurs. Abnormal diurnal asymmetry and the latitude dependence of N_m (*Proc. Fourth Meeting Mixed Commission on the Ionosphere*, 1955, p. 14) together confirm the presence of ionospheric currents of the type predicted by Balfour Stewart in 1882.

551.510.535 : 523.78 **753**

Electron Production and Recombination in the E-Layer.—C. M. Minnis. (*J. atmos. terr. Phys.*, Sept. 1955, Vol. 7, No. 3, p. 172.) An error in a previous paper is pointed out; corrected values reinforce the conclusion reached.

551.510.535 : 621.3.087.4 **754**

Measurement of Ionospheric Heights by the Method of Delayed Coincidence.—H. Rakshit & S. D. Chatterjee. (*Z. Phys.*, 20th Sept. 1955, Vol. 141, No. 5, pp. 540–549. In English.) See 713 of 1955.

551.510.535 : 621.396.11 **755**

The Physics of the Ionosphere.—Publishers: The Physical Society, London, 1955, 406 pp., 40s. This report contains the text of the following papers presented at the conference noted previously (1340 of 1955):—

Survey: The Lowest Ionosphere.—A. H. Waynick (pp. 1–13).

Ionospheric Absorption at Low and Medium Frequencies.—G. McK. Allcock (pp. 14–19).

Ionospheric Layer Formation under Quasi-stationary Conditions.—E. Appleton & A. J. Lyon (pp. 20–39).

A Study of Vertical-Incidence Ionospheric Absorption at 2 Mc/s.—W. J. G. Beynon & K. Davies (pp. 40–52).

Short-Wave Echoes from the Lower Ionosphere.—W. Dieminger (pp. 53–57).

Solar X-Ray Emission and the Height of the D Layer during Radio Fade-Out.—H. Friedman & T. A. Chubb (pp. 58–62).

D-Region Echoes with a Radio Wave of Frequency 1·4 Mc/s.—S. Gnanalingam & K. Weekes (pp. 63–70).

Self-Gyrointeraction.—S. N. Mitra (pp. 71–73).

The Observed Polarization of High-Frequency Sky-Wave Signals at Vertical Incidence.—M. G. Morgan & W. C. Johnson (pp. 74–77).

M-Type Ionospheric Reflections at 150 kc/s.—R. L. Schrag (pp. 78–87).

Survey: A Survey of Existing Knowledge of Irregularities and Horizontal Movements in the Ionosphere.—J. A. Ratcliffe (pp. 88–98).

Scattering at Oblique Incidence from Ionospheric Irregularities.—Summary by J. A. Ratcliffe of informal talk by D. K. Bailey (pp. 99–100).

Variations of the F_2-Layer Critical Frequency during Undisturbed Ionospheric Conditions.—W. Becker (pp. 101–103, in German with English abstract).

Interpretation of Drift of Field-Strength Nonuniformities as Ionospheric Winds.—H. Berg (pp. 104–112, in German with English abstract).

Some Observations of Ionospheric Movements.—K. Bibl, E. Harnischmacher & K. Rawer (pp. 113–118).

An Empirical Study of Random Functions which arise in the Interpretation of Ionospheric Movements.—B. H. Briggs & E. S. Page (pp. 119–122).

The Variability of Time Shifts in Measurements of Ionospheric Movements.—B. H. Briggs & M. Spencer (pp. 123–135).

A Note on the Motion of a Cylindrical Irregularity in an Ionized Medium.—P. C. Clemmow, M. A. Johnson & K. Weekes (pp. 136–139).

Statistical Analysis of Star Scintillations as a Means for investigating Atmospheric Disturbances.—R. Fürth (pp. 140–149).

Irregularities in the E Region caused by Atmospheric Electricity.—G. A. Isted (pp. 150–162).

Interpretation of Observed F_2 'Winds' as Ionization Drifts associated with the Magnetic Variations.—D. F. Martyn (pp. 163–165).

Investigation of F-Region Drift Movements by Observations of Radio Star Fading.—A. Maxwell (pp. 166–171).

Radio Star Scintillations due to Ionospheric Focusing.—J. L. Pawsey (pp. 172–173).

Diffuse Ionospheric Reflection of Medium Waves at Night.—G. J. Phillips (pp. 174–180).

Travelling Disturbances in the Ionosphere.—R. E. Price (pp. 181–190).

Measurement of Ionospheric Wind from the Drift Velocity of a Condition (e.g. Field Strength of Echo) along the Surface of the Earth.—P. St. Pütter (pp. 191–201, in German with English abstract).

A Method for studying Large-Scale Irregularities in Region E of the Ionosphere.—R. L. Schrag (pp. 202–211).

Survey: A Survey of Present Knowledge of the F_2 Region.—D. F. Martyn (pp. 212–218).

Storm Phenomena and the Solar-Cycle Variations of the F_2-Layer Ionization at Noon.—E. Appleton & W. R. Piggott (pp. 219–228).

Electrodynamics of the Outer Atmosphere.—J. W. Dungey (pp. 229–236).

The Ionospheric F_2 Region.—R. J. Havens, H. Friedman & E. O. Hulburt (pp. 237–244).

Geomagnetic Distortion in the F_2 Layer.—K. I. Maeda (pp. 245–253).

Theory of Height and Ionization Density Changes at the Maximum of a Chapman-Like Region, taking account of Ion Production, Decay, Diffusion and Tidal Drift.—D. F. Martyn (pp. 254–259).

Geomagnetic Anomalies of the F_2 Region and their Interpretation.—D. F. Martyn (pp. 260–264).

Ionospheric F_2 Variations associated with Geomagnetic Disturbances at the Equatorial Zone.—S. Matsushita (pp. 265–269).

Information about the F_2 Layer taken from Ionization Maps.—K. Rawer (pp. 270–275).

Survey: The Mathematics of Wave Propagation through the Ionosphere.—K. G. Budden (pp. 276–287).

Propagation of a Plane Wave in a Transparent Anisotropic Ionized Medium and Propagation in a Heterogeneous Ionized Medium.—É. Argence (pp. 288–298, in French).

Electron Density and Ray Tracing in the Ionosphere Layers.—P. A. Bricout (pp. 299–307).

The Transient Response of the Ionosphere at Low Frequencies.—S. A. Bowhill (pp. 308–319).

The Nonexistence of a 'Fourth Reflection Condition' for Radio Waves in the Ionosphere.—K. G. Budden (pp. 320–331).

A Method for determining the Variation of Electron Density with Height ($N(z)$ curves) from Curves of Equivalent Height versus Frequency (h', f curves).—K. G. Budden (pp. 332–339).

The Dependence of the Refractive Index in Magneto-ionic Theory on the Direction of the Wave Normal.—P. C. Clemmow & R. F. Mullaly (pp. 340–350).

Methods of solving the Coupled Equations of Plane Wave Propagation in the Ionosphere.—J. J. Gibbons (pp. 351–354).

Ray Theory and a New Method for Ray Tracing.—J. Haselgrove (pp. 355–364).

Statistical Mechanics of Lorentz-Type Electron Plasmas and Applications to the Ionosphere.—R. Jancel & T. Kahan (pp. 365–373, in French).

Analysis of the Coupling of the Ordinary and Extraordinary Electromagnetic Waves in a Lorentz-Type Plasma and Application to the Ionosphere.—R. Jancel & T. Kahan (pp. 374–383, in French).

Graphical Constructions for Ray-Tracing in the Ionosphere.—R. F. Mullaly (pp. 384–393).

Studies of the Refractive Index in the Ionosphere: the Effect of the Collision Frequency and of Ions.—W. Pfister (pp. 394–401).

Tables of Group Refractive Index for the Ordinary Ray in the Ionosphere.—D. H. Shinn (pp. 402–406).

551.510.535 : 621.396.812.3 **756**

Three Components of the Field Strength of the Wave reflected from the Surface of the Ionosphere, their Level and Time Variation.—Uyeda, Ogata, Uchikura, Arima & Obayashi. (See 900.)

551.515.4 : 621.396.96 **757**

Radar Observations of a Thunderstorm.—Mitra. (See 765.)

LOCATION AND AIDS TO NAVIGATION

621.396.93 **758**

Adcock Direction Finder.—W. C. Bain. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, pp. 20–24.) "It was found that the pull of the triatics (supporting the central sense aerial) on the main aerials of an Adcock h.f. direction finder caused the main aerials to bend inwards, so that a large polarization error was produced on frequencies near 20 Mc/s. Theoretical calculations are made for the case of aerials with an overall slope of 1°, with a distant loop transmitter at 6·3° elevation and with a loop tilt of 6° from the horizontal: the total polarization error found is 6° for a perfectly-reflecting ground and 19° for ground of conductivity 0·02 mho/m. In practical direction finding the errors are not likely to be as high as this on the average; but the figure of 3° is obtained for the root-mean-square error from a transmitter on 20 Mc/s at 20° elevation despite the small amount of aerial bending assumed."

621.396.932/.933 **759**

Night Effect in the Consol Navigation System.—R. Kümmich. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, pp. 494–500.) It is shown that the combination of the ground wave with the sky wave causes deviation of all the beams except the main one; in some cases the rhythm of the signal is also disturbed.

621.396.932/.933 **760**

Accuracy of the 'Sonne' [consol] **Navigation System.**—K. Rawer. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, p. 501.) Brief note summarizing results of an unpublished 1944 report on an extensive series of observations. Night-time deviations and scatter of observations were consistent with present-day knowledge of ionospheric propagation.

621.396.933 **761**

Long-Range Radio Navigation in the Long-Wave Band.—E. Roessler. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, pp. 485–489.) The Navaglobe-Navarho system [432 of 1955 (Clark et al.)] is discussed and compared with other systems in use, from the point of view of the number of ground stations required, the bandwidth requirements and the sensitiveness to noise.

621.396.933.1 : 621.397.5 **762**

Telegee.—D. A. Levell. (*Wireless World*, Jan. 1956, Vol. 62, No. 1, pp. 41–42.) The possibility of using existing synchronized television transmitters for determining the position of aircraft is discussed. An aircraft would need to receive three television stations; the times of arrival of corresponding frame synchronizing pulses could be measured and position determined as in the Gee and Decca systems.

621.396.96 **763**

Experimental Study of Rain Echoes using 3-cm-λ Pulsed Radar with Circular Polarization.—M. Bouix, M. Clément & C. Frémiot. (*Ann. Télécommun.*, July/Aug. 1955, Vol. 10, Nos. 7/8, pp. 159–168.) Observations were made using radar equipment with two different types of aerial permitting rapid transition from linear to circular polarization; constructional details are given. Results confirm that rain clutter is reduced by using circular polarization at this wavelength.

621.396.96 : 551.510.5 **764**

Resolution in Height of a Radar Pulse.—V. G. Miles. (*J. Met.*, April 1955, Vol. 12, No. 2, pp. 107–110.) "An analysis is made of the ability of a radar pulse to resolve, either completely or partially, the echoes from two closely-spaced horizontal reflecting layers situated close to the radar. The general expressions obtained are illustrated graphically." See also 3306 of 1953.

621.396.96 : 551.515.4 **765**

Radar Observations of a Thunderstorm.—H. Mitra. (*Indian J. Met. Geophys.*, April 1955, Vol. 6, No. 2, pp. 119–136.) A detailed illustrated account. The radar echoes as displayed on a 3-cm-λ Type-AN/APQ-13 set are explained by reference to meteorological data.

MATERIALS AND SUBSIDIARY TECHNIQUES

533.5 : 535.33 **766**

The Emission of Light from Gas Discharges in High Vacuum.—K. H. Reiss. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 433–437.) A method of analysing gases at low pressure is based on their emission spectra. A specially constructed ionization manometer with cold electrodes is used as light source. Apparatus including filter, photomultiplier and recorder is described. The technique is useful for testing vacuum apparatus for leaks.

533.5 : 621.3.032.73 **767**

Outgassing of Glass.—B. J. Todd. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1238–1243.) The temperature dependence of the water-diffusion rate in vacuum has been determined for several glasses. From the results it is possible to calculate the amount of water that will be evolved from glass for any time-temperature conditions following any bake-out in which the surface gases have been removed.

535.215 : [537.311.33 + 537.226 **768**

Performance of Photoconductors.—A. Rose. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1850–1869.) A survey paper. A phenomenological analysis is made of processes whereby the conductance of a semiconductor or insulator material is increased by exposure to radiation (including particle radiation but excluding thermal radiation); the theory is based on consideration of bound energy states. The lifetime of free carriers is an important characteristic parameter. The mechanism of conduction at barriers is discussed and noise phenomena are examined. 54 references.

535.215 : 537.311.33 **769**

Photoeffects in Intermetallic Compounds.—H. P. R. Frederikse & R. F. Blunt. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1828–1835.) "The intermetallic semiconductors are classified with respect to their crystal structure and to the place of the component elements in the periodic system. A survey is given of the properties of compounds with the zincblende and fluorite lattice. Photoeffects of individual members of these two groups are discussed. Such phenomena include photoconduction, photovoltage, and the photoelectro-magnetic effect." 40 references.

535.215 : 537.311.33 **770**

Photoconductivity of the Sulfide, Selenide, and Telluride of Zinc or Cadmium.—R. H. Bube. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1836–1850.) Recent research on evaporated, powder and sintered layers and on single-crystal specimens is reviewed. The aspects discussed include spectral response, impurity sensitization, electrode contact problems, speed of response, dependence of photocurrent on illumination intensity and on temperature, infrared quenching and thermal stimulation, as well as related luminescence, photovoltaic and photoemissive effects. 118 references.

535.215 : 537.311.33 : 546.26-1 **771**

Photoelectric Emission from Polycrystalline Graphite.—E. Taft & L. Apker. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1831–1832.) Results of measurements of the energy distribution of the photoelectrons are reported. The photoelectric yield from graphite is about a tenth that from common metals.

535.215 : 537.311.33 : [546.28 + 546.289 **772**

Photoconduction in Germanium and Silicon.—M. L. Schultz & G. A. Morton. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1819–1828.) A general account based on energy-band theory is presented explaining the photoconducting properties of Ge and Si both with and without added impurities. 58 references.

535.215 : 537.311.33 : 621.383.4 **773**

Lead Salt Photoconductors.—T. S. Moss. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1869–1881.) A review paper discussing the mechanism of photoconductivity in PbS, PbTe and PbSe and its application in high-sensitivity infrared-radiation detectors. The manufacture of photocells using these materials is outlined. 130 references.

535.37 : 535.34 : 546.482.21 **774**

The Absorption Spectrum of Excited Crystals of Cadmium Sulphide.—A. Halperin & G. F. J. Garlick. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 758–765.) Single crystals of CdS excited by light of wavelength 0·546 μ exhibited absorption bands extending from the excitation wavelength to 1·4 μ with a maximum intensity at 0·78 μ. Variations caused by temperature changes are discussed on the basis of electron and hole trapping and recombination.

535.37 : 546.472.21 **775**

Investigation of the Accumulation Property and Origin of Levels of Localization of Electrons in Zinc-Sulphide Phosphors.—N. V. Zhukova. (*C. R. Acad. Sci. U.R.S.S.*, 21st Aug. 1955, Vol. 103, No. 6, pp. 1001–1004. In Russian.)

535.37 : 546.472.21 **776**

Luminescent Centres in ZnS:Cu:Cl Phosphors.—R. Bowers & N. T. Melamed. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1781–1787.)

535.37 : 546.472.21 : 535.215 : 537.311.33 **777**

Photoluminescent Modulation in Nonuniformly Excited ZnS Phosphors.—R. E. Halsted. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, p. 1897.) Experiments are briefly described in which phosphors were excited by radiation of wavelengths shorter than that corresponding to the fundamental absorption edge, while subjected to an alternating field of frequency ranging from 20 c/s to 20 kc/s. The results demonstrate the *n*-type photoconductivity of the phosphors and clarify the role of conduction electrons in the luminescence process.

535.37.07 : 548.0 **778**

The Physical Chemistry of Crystal Phosphors.—F. A. Kröger. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1941–1944.) A brief survey of inorganic crystal phosphors, with particular attention to the incorporation of atoms with a valency different from that of the main material, and to the stabilization of atoms in a particular valency.

535.376 **779**

Cathodoluminescence.—G. F. J. Garlick. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1907–1911.) A brief review of recent advances in knowledge of the fundamental mechanisms involved. Observed brightness/voltage characteristics are related to the microcrystalline form of the phosphor; simpler behaviour is exhibited by single crystals. Factors affecting screen efficiency are discussed, as are also current saturation and 'electron burn'.

535.376 **780**

Electroluminescence and Related Topics.—G. Destriau & H. F. Ivey. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1911–1940.) A comprehensive review with 162 references.

535.376 : 546.472.21 **781**

Electroluminescence in Single Crystals of Zinc Sulphide.—G. F. Alfrey & J. B. Taylor. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 775–784.) Experimental work is described and the bearing of the results on previously proposed theories of the mechanism of electroluminescence is discussed. Predicted temperature and frequency variations of electroluminescence in good agreement with observed values are obtained on the basis of a field-emission theory assuming a particular formation of the surface barrier.

535.376 : 546.472.21 : 537.226.2 **782**

The Electrical Properties of Electroluminescent Phosphors.—A. N. Ince & C. W. Oatley. (*Phil. Mag.*, Oct. 1955, Vol. 46, No. 381, pp. 1081–1103.) The frequency variations of ϵ_1 and ϵ_2, the components of the complex permittivity $\epsilon_1 - j\epsilon_2$, were experimentally determined for activated ZnS both in the dark and under ultraviolet illumination. Results suggest that two different mechanisms are involved. One, which is present in the dark, produces dispersion at low frequencies; it is characteristic of electroluminescent phosphors. The other, which is stimulated by ultraviolet light, produces dispersion similar to that found in ordinary non-electroluminescent phosphors. The effects are explained on the assumption that electronic barriers are formed in the specimen and that some of the ions in the barrier region are mobile.

535.376 : 621.385.832 : 535.623 **783**

Phosphors for Tricolour Television Tubes.—A. Bril & H. A. Klasens. (*Philips Res. Rep.*, Oct. 1955, Vol. 10, No. 5, pp. 305–318.) Measurements of the efficiency and spectral distribution of various phosphors indicate that the properties of the red phosphor are most important; compromise is necessary between colour rendering and efficiency. (Zn,Cd)S-Ag and (Zn,Cd) Se-Cu phosphors can be produced with higher efficiencies for near-white colours than ZnP-Mn. The properties of a number of phosphors are shown in tables and graphs.

537.226/.228 **784**

Nonlinear Dielectric Materials.—E. T. Jaynes. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1733–1737.) A brief discussion of materials in which dielectric properties depend on applied field strength. Since ferroelectric materials have high dielectric constants they may be expected to exhibit a high degree of nonlinearity.

537.226/.227 **785**

Some Aspects of Ferroelectricity.—G. Shirane, F. Jona & R. Pepinsky. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1738–1793.) A survey with over 160 references. The behaviour of ferroelectric and antiferroelectric materials is related to their domain and crystal structure. Numerous photographs and diagrams illustrate the phenomena described.

537.226/.227 : 546.817.824 **786**

X-Ray Study of Phase Transition of Ferroelectric $PbTiO_3$ at Low Temperature.—J. Kobayashi & R. Ueda. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1900–1901.)

537.226.2 **787**

The Permittivity of Two-Phase Mixtures.—C. A. R. Pearce. (*Brit. J. appl. Phys.*, Oct. 1955, Vol. 6, No. 10, pp. 358–361.) Experimental results obtained by various workers are compared with predictions from published formulae relating the properties of a mixture with those of the phases composing it. An empirical expression is presented which gives adequate agreement with all relevant available results.

537.226.2 : 546.431.824-31 **788**

Permittivity of Barium Titanate.—I. P. Kozlobaev. (*C. R. Acad. Sci. U.R.S.S.*, 21st Sept. 1955, Vol. 104, No. 3, pp. 387–388. In Russian.) Experimental results, presented graphically, show that ϵ decreases as the hydrostatic pressure increases from atmospheric to 4 000 kg/cm². A mechanical hysteresis effect was also observed; in a specimen with a Curie temperature Θ of about 127°C, the final value of ϵ at atmospheric pressure was greater than the initial value at high pressure, while in specimens with Θ about 10°–20°C above room temperature this difference was smaller, and in a specimen with $\Theta = 1$°C the final value was smaller than the initial one. The relaxation of internal stresses, as indicated by changes in ϵ, is practically complete in about 20 min.

537.228.1 **789**

Anisotropy of Polarized Polycrystalline Barium Titanate.—D. S. Moseley. (*J. acoust. Soc. Amer.*, Sept. 1955, Vol. 27, No. 5, pp. 947–950.) Observations were made of the longitudinal vibrations of $BaTiO_3$ specimens subjected to a range of polarization conditions; pairs of bars $1 \times \frac{1}{4} \times \frac{1}{4}$ in. were used, one of each pair having electrodes applied to the ends and the other having electrodes on opposite long sides. The effect of different treatments on the ratio between the elastic compliances at constant electric field and at constant electric displacement is indicated and discussed.

537.311.31 : 546.56–1 **790**

Effect of Point Imperfections on the Electrical Properties of Copper: Part 1—Conductivity.—F. J. Blatt. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1708–1716.) Detailed calculations are presented for the scattering of conduction electrons by lattice imperfections in Cu.

537.311.33 **791**

Unipolar Conduction at the Semiconductor/Metal Boundary.—E. Wallauschek. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 351–366.) Measurements on silver/silver-iodide cells are reported; the current/time characteristics for the forward and reverse directions are different. A unipolar conduction mechanism responsible for this asymmetry is discussed.

537.311.33 **792**

Carrier-Concentration Disturbances in Semiconductors.—R. E. Burgess. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, p. 793.) Critical comment on a paper by Low (3296 of 1955).

537.311.33 **793**

Fluctuations of the Numbers of Electrons and Holes in a Semiconductor.—R. E. Burgess. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 661–671.) Fluctuations are calculated by either (*a*) a thermodynamical method, in terms of the electronic free energy of the system whose minimal properties are used to determine the equilibrium distribution and fluctuations of electrons between the conduction and valence bands and the impurity levels, or (*b*) a statistical method based on the probabilities of the elementary processes of electron transitions between energy levels. The first method is particularly useful in complex cases. Both intrinsic and extrinsic semiconductors are discussed, as well as the case of a nearly intrinsic semiconductor.

537.311.33 **794**

Theory of the Infrared Absorption by Carriers in Semiconductors.—R. B. Dingle. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1901–1902.) Critical discussion of theory presented by Kahn (2649 of 1955).

537.311.33 **795**

Surface Recombination and the 'Light-Disk' Method of measuring Bulk-Lifetime in Semiconductors.—J. Butterworth. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 293–296.) The method considered is broadly the same as that discussed e.g. by van Roosbroeck (2644 of 1955), but the linear dimensions of the illuminated area at which minority carriers are injected are assumed to be comparable with the diffusion length. Two expressions useful for analysing experimental data are derived, valid for complementary ranges of the system parameters.

537.311.33 **796**

A Comparison of some Methods for the Determination of Trace Impurities in Semiconductors.—A. A. Smales. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 327–332.) A discussion of analytical methods; coulometry, X-ray spectroscopy, microbiological and magnetic-resonance techniques are excluded.

537.311.33 **797**

History of Semiconductor Research.—G. L. Pearson & W. H. Brattain. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1794–1806.) An account going back to Faraday's observation in 1833 of the negative temperature coefficient of resistance of silver sulphide; most of the emphasis is on the work leading up to the development of the transistor. 118 references.

537.311.33 : 535.37 **798**

Radiative Transitions in Semiconductors.—R. Braunstein. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1892–1893.) Observations are reported of radiation produced by carrier injection into thin plates of GaSb, GaAs, InP and Ge-Si alloys, at room temperature and at 77°K; an outline is given of the technique used. The spectral distributions exhibit peaks at energy values close to previously estimated values of the energy gaps.

537.311.33 : 536.2 **799**

Thermal Conductivity of Semiconductors.—J. M. Thuillier. (*C. R. Acad. Sci., Paris*, 24th Oct. 1955, Vol. 241, No. 17, pp. 1121–1122.) An exact calculation indicates that the ratio between the electrical contribution to the thermal conductivity and the electrical conductivity may be much greater than the value predicted by the Lorentz theory for an electron gas.

537.311.33 : 537.533.8 **800**

New Ni-Be Alloy with [high] **Secondary Emissivity.**—J. Millet. (*Le Vide*, July–Sept. 1955, Vol. 10, Nos. 58/59, pp. 96–102.) A description of the preparation of Ni-Be and Ni-Mg alloys suitable for use as nonlinear resistors. The structure and physical properties of the alloys are discussed with the aid of microphotographs. The electrical properties are discussed in a paper by Bobenrieth et al. (776 of 1955). See also 434 of 1954 (Teszner et al.).

537.311.33 : 538.632 **801**

Saturation Hall Constant of Semiconductors.—J. A. Swanson. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1799–1807.) Analysis is presented for the motion of electrons in semiconductor crystals in the presence of crossed electric and magnetic fields. For increasing values of the magnetic field the value of the Hall constant tends asymptotically to $1/(p-n)ec$ where p and n are the hole and electron concentrations and e and c have their usual significance; this value is unaffected by scattering. The saturation magnetoresistance is also discussed.

537.311.33 : 546.23 **802**

Fixation of Iodine in Selenium.—R. A. Hyman & D. H. Tomlin. (*Nature, Lond.*, 19th Nov. 1955, Vol. 176, No. 4490, p. 977.) Brief report of experimental results indicating that halogen atoms can be bound in the Se structure, probably at the ends of chains of Se atoms. This conclusion does not agree with that of Nijland (744 of 1955).

537.311.33 : 546.26-1 **803**

Recent Investigations on Graphite.—R. Arnold. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 453–460.) A review with 58 references.

537.311.33 : 546.27 **804**

Study of the Frequency Dispersion of the Conductivity of Boron and of $B_{12}Al$.—J. Lagrenaudie. (*J. Phys. Radium*, Aug./Sept. 1955, Vol. 16, Nos. 8/9, pp. 731–732.) Report of measurements at frequencies in the range 100 c/s–1 Mc/s and temperatures down to 110°K, using specimens solidified after fusion. The dispersion of conductivity is attributed to nonuniform distribution of impurities. Estimates are made of activation energies of impurities.

537.311.33 : [546.28 + 546.289 **805**

Effect of Water Vapor on Grown Germanium and Silicon *np* Junction Units.—J. T. Law & P. S. Meigs. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1265–1273.) Photoresponse and reverse current were measured over a wide range of water-vapour pressures. At low relative humidities the surface recombination rate for Ge decreases relative to the value in vacuum, but Si is not affected. Humidities above 30% produce channels on

both Ge and Si units. Channel length varied with voltage as observed by McWhorter & Kingston (3587 of 1954). Steady illumination decreased the channel length on both Ge and Si units, but affected the excess reverse current only for Si; hence some mechanism other than channel conduction, probably an ionic mechanism, is operative at Ge surfaces. The existence of the two mechanisms is consistent with Christensen's results (3585 of 1954). See also 3586 of 1954 (Law).

537.311.33 : [546.28 + 546.289] : 548.0 **806**

The Electronic Energy-Band Structure of Silicon and Germanium.—F. Herman. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1703–1732.) This introduction to the physics of crystals covers electronic quantum states, the hole concept, the effective mass tensor, motion of electrons and holes, spin-orbit interaction, the energy-band structure of Si and Ge and their alloys, theory of lattice vibrations, the phonon concept, collisions between electrons or holes and phonons, electrical conductivity, and optical phenomena. Over 70 references.

537.311.33 : 546.289 **807**

Nature of the Water-Vapor-Induced Excess Current on Grown Germanium *p-n* Junctions.—E. N. Clarke. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1899–1900.)

537.311.33 : 546.289 **808**

Theory of Acceptor Levels in Germanium.—W. Kohn & D. Schechter. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1903–1904.) Calculations based on the coupled effective-mass equations applicable for a degenerate band structure give a value for the ionization energy in good agreement with observations.

537.311.33 : 546.289 **809**

Diffusion of Antimony, Arsenic and Indium into Solid Germanium.—W. Bösenberg. (*Z. Naturf.*, April 1955, Vol. 10a, No. 4, pp. 285–291.) Steep impurity-concentration profiles develop during the preparation of Ge single crystals by pulling, if impurities are incorporated in the melt. The flattening of the slope due to diffusion is determined by impedance measurements; impurity concentrations between 1 in 10^5 and 1 in 10^7 atomic parts are used. Values of the diffusion coefficients are hence derived. The same values are obtained when thin films of the impurity metals are evaporated on to the Ge and allowed to diffuse into the interior.

537.311.33 : 546.289 : 535.215 **810**

Analysis of the Decay of Photoconductance in Germanium.—B. H. Schultz. (*Philips Res. Rep.*, Oct. 1955, Vol. 10, No. 5, pp. 337–348.) "A method of analyzing surface and volume effects in the recombination of injected charge carriers is described. The influence of the capacity of a surface double layer is discussed and some of the results of measurements are given."

537.311.33 : 546.289 : 548.0 **811**

Structural Changes in Evaporated Ge Films in an Electron Microscope.—E. W. Fischer & H. Richter. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 193–209.) A photographically illustrated report of changes induced by the impact of the electron beam.

537.311.33 : 546.3-1-28-289 **812**

Electrical Properties of Germanium-Silicon Alloys.—A. Levitas. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1810–1814.) Various specimens were investigated; resistivity measurements were made over the temperature range 300°–800°K, and Hall-effect and resistivity measurements over the temperature range 77°–300°K. Intrinsic resistivity at room temperature is plotted against percentage Si in the alloy, by extrapolation from the high-temperature measurements. The observed variation of mobility with alloy composition is indicative of alloy scattering.

537.311.33 : 546.682.86 **813**

Thermoelectric Power of Indium Antimonide.—H. P. R. Frederikse & E. V. Mielczarek. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1889–1890.) Measurements of the thermoelectric power of a *p*-type and an *n*-type specimen over the temperature range 60°–400°K are reported; wide differences are found between the two characteristics.

537.311.33 : 546.682.86 **814**

Infrared Absorption in Indium Antimonide.—W. G. Spitzer & H. Y. Fan. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1893–1894.) Measurement results are presented as transmission/wavelength and reflectivity/wavelength curves.

537.311.33 : 546.682.86 **815**

Optical Absorption Limit and Effective Mass of Electrons in Indium Antimonide (InSb).—P. Aigrain & J. des Cloizeaux. (*C. R. Acad. Sci., Paris*, 3rd Oct. 1955, Vol. 241, No. 14, pp. 859–862.) Calculations are made which provide an explanation of the discrepancy between the values of the effective electron mass found by Burstein (2134 of 1954) and by Dresselhaus et al. (3011 of 1955). The analysis is based on the potential distribution due to impurity centres, and its application is not restricted to InSb.

537.311.33 : 546.817.221 **816**

Measurements on *p-n* Junctions in Lead Sulphide.—T. S. Moss. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 697–700.) "From measurements of the characteristics of several natural *p-n* junctions the intrinsic resistivity of lead sulphide is calculated to be 3·1 Ω.cm. Hence at room temperature the intrinsic carrier concentration is $2{\cdot}7 \times 10^{15}$ electrons or holes per cm^3 and the width of the forbidden zone 0·40 eV."

537.311.33 : 621.396.822 **817**

Contribution on the 1/*f* Law of Noise in Semiconductors.—H. Schönfeld. (*Z. Naturf.*, April 1955, Vol. 10a, No. 4, pp. 291–300.) Explanations of the $1/f$ spectral distribution of current noise in semiconductors given by van der Ziel (3035 of 1950) and by Surdin (1325 of 1952) are based on assumptions not previously justified. It is shown that discrete phenomena distributed according to a $t^{-\frac{1}{2}}$ time law also give rise to a $1/f$ spectral distribution. This is discussed in relation to Montgomery's hypothesis (122 of 1953) that the discrete phenomena correspond to the local injection of minority carriers.

537.311.33 : 621.396.822 **818**

Distribution Function of Semiconductor Noise.—D. A. Bell. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 690–691.) An experiment is described confirming that the Gaussian distribution of instantaneous values applying to 'white noise' applies also to current noise with inverse-frequency spectrum.

537.311.33 : 669.046.54/.55 **819**

Zone-Melting Processes under Influence of the Atmosphere.—J. van den Boomgaard. (*Philips Res. Rep.*, Oct. 1955, Vol. 10, No. 5, pp. 319–336.) Theory

presented previously [e.g. 740 of 1955 (Reiss)] is extended to deal with the case of elements containing volatile solutes; it is possible to introduce a volatile impurity element homogeneously into an ingot by means of zone melting under a constant vapour pressure of that element.

537.311.33 : 669.046.54/.55 : 512.831 **820**

On Zone Refining.—J. L. Birman. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1195–1197.) "A matrix method is used to solve the difference equations which describe the zone refining of a bar. The matrix method is designed for direct numerical calculation of the solute distribution, after any number of passes, with any initial solute distribution. The method is illustrated with a simple example."

537.311.33.01 + 535.37.01 **821**

Statistical-Kinetic Theory of Luminescence and Electrical Conductivity of Impurity Semiconductors.—I. Broser & R. Broser-Warminsky. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 361–407.) By using statistical rather than kinetic considerations the mathematical analysis is simplified, and restrictive assumptions regarding discrete energy levels can be discarded.

538 : 536.48 **822**

Conference on Low-Temperature Magnetism: Khar'kov, 1st–3rd July 1954.—(*Bull. Acad. Sci. U.R.S.S., sér. phys.*, July/Aug. 1955, Vol. 19, No. 4, pp. 387–488. In Russian.) The issue contains a summary of the 20 papers read at the conference and texts of nine papers including:

Galvanomagnetic Phenomena and Properties of Conduction Electrons in Metals.—E. S. Borovik (pp. 429–443).

Investigation of Photomagnetoelectric Effect in Cuprous Oxide at Low Temperatures.—A. P. Komar, N. M. Reinov & S. S. Shalyt (pp. 444–446).

Electrical Conductivity of Ferromagnetic Metals at Low Temperatures.—E. A. Turov (pp. 474–480).

538.221 **823**

The Direct Separation of the Reversible and Irreversible Components of the Magnetothermal Effect.—L. F. Bates & N. P. R. Sherry. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 642–648.) The two components are separated by effecting small 'backward' increments in magnetization at given points in the hysteresis cycle. Results are reported for cobalt.

538.221 **824**

Investigation by Powder-Pattern Method of the Magnetic Structure of Silicon-Iron Crystals.—Ya. S. Shur & V. R. Abel's. (*C. R. Acad. Sci. U.R.S.S.*, 11th Sept. 1955, Vol. 104, No. 2, pp. 209–210. In Russian.) From the photographs shown, general relations are deduced of the dependence of magnetic structure on the crystallographic orientation of the specimen surface.

538.221 **825**

Shape and Crystal Anisotropy of Alnico 5.—E. A. Nesbitt & H. J. Williams. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1217–1221.) An investigation made using the torque-measurement technique previously described [172 of 1955 (Nesbitt et al.)] indicates that the high coercive force of single crystals of alnico 5 depends on the shape anisotropy of the fine precipitated plates, the crystal anisotropy being negligible. The plates are composed of rods of diameter about 75 Å and length 400 Å, but exhibit single-domain properties.

538.221 **826**

Permanent-Magnet Properties of Elongated Single-Domain Iron Particles.—L. I. Mendelsohn, F. E. Luborsky & T. O. Paine. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1274–1280.) An account is given of measurements on magnets made by aligning and compacting single-domain particles of diameter 150 Å with a median length/diameter ratio of 3 and an intrinsic coercive force before packing of 1 600 oersted. The influence of packing fraction and degree of alignment were investigated. BH_{max} values $> 3 \times 10^6$ G. oersted were obtained. The results are compared with theoretical predictions and with the corresponding properties of existing permanent-magnet materials.

538.221 **827**

The Effect of Particle Interaction on the Coercive Force of Ferromagnetic Micropowders.—E. P. Wohlfarth. (*Proc. roy. Soc. A*, 25th Oct. 1955, Vol. 232, No. 1189, pp. 208–227.) Analysis is presented for an assembly of prolate-spheroidal single-domain particles, with either parallel or nonparallel arrangement. The principal effects discussed are the dependence of the shape-anisotropy coefficient on the interaction and a mutual magnetization change due to an interaction-dependent rotation of the magnetization vectors. A general expression is derived for the coercive force in terms of packing factor and saturation magnetization; this is contrasted with formulae obtained previously based on an 'effective field' treatment.

538.221 **828**

Production of Anisotropy in a Permanent Magnet by Pressure.—J. E. Gould & M. McCaig. (*Nature, Lond.*, 19th Nov. 1955, Vol. 176, No. 4490, p. 977.) The 'squareness' of the B/H curve of a rod of 35% Co steel was improved by shrinking a stainless-steel block around it so as to exert lateral pressure. The method is similar to that applied to ferroxcube by Wijn et al. (*Philips tech. Rev.*, 1954, Vol. 16, p. 49). See also 3608 of 1954 (Wijn).

538.221 : 538.569.4.029.6 **829**

Ferromagnetic Resonance in Nickel and in some of its Alloys.—K. J. Standley & K. H. Reich. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 713–722.) Report of determination of g values and line widths for polycrystalline specimens of Ni and of Ni-Cu, Ni-Al, Ni-Sb and Ni-Mn alloys with high Ni content, from resonance measurements at 1·22-cm λ, mainly over the temperature range from 20°C to 200°C.

538.221 : [621.318.124 + 621.318.134 **830**

Some Properties of Ferrites in connection with their Chemistry.—E. W. Gorter. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1945–1973.) Introductory and survey paper, including 63 references. Aspects discussed include ferromagnetic resonance, dimensional resonance, relaxation phenomena, and their relation to permeability.

538.221 : [621.318.124 + 621.318.134 **831**

Anisotropy and Magnetostriction of some Ferrites.—R. M. Bozorth, E. F. Tilden & A. J. Williams. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1788–1798.) Measurements are reported on Co, CoZn and other ferrites, some single-crystal and others polycrystalline. Crystal anisotropy was investigated by the torque technique; values up to 4×10^6 ergs/cm^3 were found. Magnetostriction was determined by strain-gauge technique; values up to 800×10^{-6} were found. Magnetic annealing is effective at temperatures as low as 150°C, and causes the hysteresis loop to become 'square'. In

polycrystalline Co ferrites magnetic annealing is most effective for compositions between $CoFe_2O_4$ and Fe_3O_4. The constants for the various specimens are tabulated and discussed.

538.221 : 621.318.124 **832**

Studies on the Oxide Magnets: Part 1—Effects of Bi_2O_3 on Barium Ferrites. Part 2—Effects of Bi_2O_3 on Strontium and Lead Ferrites.—T. Okamura, H. Kojima & S. Watanabe. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Aug. 1955, Vol. 7, No. 4, pp. 411–424.) The saturation and remanent magnetization of a BaO-Fe_2O_3 system were increased by 20% to 30%, and the coercive force by 30% to 50%, by an addition of 1·5% Bi_2O_3; the mechanical properties improved simultaneously. The results in SrO-Fe_2O_3, SrO-CaO-Fe_2O_3 and PbO-Fe_2O_3 systems are more complex.

538.221 : [621.318.124 + 621.318.134] : 535.33/.34-1 **833**

Infrared Spectra of Ferrites.—R. D. Waldron. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1727–1735.)

538.221 : 621.318.134 **834**

First-Order Magnetic Anisotropy Constants of Ferrites.—J. B. Birks. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, p. 1821.) Potential sources of error in the method of calculation presented by Weisz (1413 of 1955) are indicated.

538.221 : 621.318.134 **835**

Frequency Dependence of Magnetocrystalline Anisotropy.—R. M. Bozorth, B. B. Cetlin, J. K. Galt, F. R. Merritt & W. A. Yager. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, p. 1898.) Differences are observed between the values of crystal anisotropy of Ni and Mn ferrites measured by static and microwave methods. Conclusions are drawn regarding the structure of the materials.

539.23 : 537.311.31 : 546.59 **836**

Study of Transparent, Highly Conducting Gold Films.—E. J. Gillham, J. S. Preston & B. E. Williams. (*Phil. Mag.*, Oct. 1955, Vol. 46, No. 381, pp. 1051–1068.) Thin gold films deposited on a substratum of bismuth oxide or, better, between two films of bismuth oxide, are found to have exceptionally high electrical conductivity and optical transmission. Typical values, for films of thickness 100 Å, are 3·5Ω/square for the resistance and 75% for the transmission.

546.681 **837**

Study of the Electrical Anisotropy of Gallium in the Neighbourhood of the Fusion Point.—I. Epelboin & M. Erny. (*C. R. Acad. Sci., Paris*, 24th Oct. 1955, Vol. 241, No. 17, pp. 1118–1121.)

548.0 : [537.311.33 + 549.514.51 **838**

Densities and Imperfections of Single Crystals.—A. Smakula, J. Kalnajs & V. Sils. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1747–1750.) The densities of Si, Al, CaF_2, CsI, Ge, TlCl, TlBr and quartz have been computed from lattice constants and molecular weights and compared with values determined by hydrostatic weighing by a method described by Smakula & Sils (*ibid.*, pp. 1744–1746). Discrepancies between the two sets of values are discussed in relation to the reliability of the basic data, and conclusions are drawn regarding the crystal imperfections.

548.0 : 537.311.33 : [546.28 + 546.289 **839**

Energy Levels of a Crystal modified by Alloying or by Pressure.—R. H. Parmenter. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1759–1766.) A perturbation method of calculating the energy levels is discussed; application to crystals with diamond-type lattice is illustrated. See also *ibid.*, pp. 1767–1776.

548.0 : 537.311.33 : 621.386 **840**

A Scanning X-Ray Camera for the Detection of Crystal Imperfections.—P. J. Holmes. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 324–326.)

549.514.51 **841**

Liquid Inclusions in Artificial Quartz.—V. P. Butuzov & N. Yu. Ikornikova. (*C. R. Acad. Sci. U.R.S.S.*, 1st Sept. 1955, Vol. 104, No. 1, pp. 76–77. In Russian.) An experimental investigation of methods for eliminating bubbles is briefly reported.

549.514.51 **842**

Experimental Evidence for Dislocations in Crystalline Quartz.—H. E. Bömmel, W. P. Mason & A. W. Warner, Jr. (*Phys. Rev.*, 15th Sept. 1955, Vol. 99, No. 6, pp. 1894–1896.)

621.315.61 : 537.533.9 **843**

Effects Produced by Metal Electrodes in Studies of Electron-Bombardment Conductivity.—J. C. Firmin & C. W. Oatley. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 620–624.) The effect of the metallic film used as an electrode in the determination of electron-bombardment-induced conductivity of crystal insulators has been investigated and its bearing on the results of earlier workers is discussed. In thick films X rays may be generated, which penetrate the specimen and produce hole/electron pairs in the body of the material.

621.315.612 **844**

Phase Equilibrium Relations in the Systems Titania-Niobia and Zirconia-Niobia.—R. S. Roth & L. W. Coughanour. (*J. Res. nat. Bur. Stand.*, Oct. 1955, Vol. 55, No. 4, pp. 209–213.) Fundamental studies on ceramic dielectrics are reported.

621.315.613.1 : 621.396.822 **845**

Pre-breakdown Current and Noise in Insulators.—D. A. Powers & T. Suita. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1244–1247.) The frequency spectrum of noise associated with pre-breakdown currents has been investigated for mica over the a.f. range. The experimental results indicate that pre-breakdown avalanches are absent or rare; the noise is apparently due to fluctuations in field-emission current.

621.315.615 **846**

Conduction and Breakdown in Hexane.—W. B. Green. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1257–1264.) Report of an experimental investigation using field strengths up to 250 kV/cm.

MATHEMATICS

512.831 : 621.3.012.1 **847**

Matrix Representation of Complex Vectors.—S. Mayr. (*Elektrotech. u. Maschinenb.*, 1st Oct. 1955, Vol. 72, No. 19, pp. 460–464.) Technique useful for dealing with e.g. parallel-connected nonlinear resistors and nonlinear quadripoles is indicated.

MEASUREMENTS AND TEST GEAR

531.788 : 537.52 : 538.6 **848**

Methods for the Measurement of Low Gas Pressures by means of a Self-Maintained Gas Discharge in a Transverse Magnetic Field.—R. Haefer. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 200–215.) The gas pressure can be determined from measurements of (*a*) the value of magnetic induction at which ignition occurs for a given voltage, (*b*) the ignition voltage for a given magnetic induction, (*c*) the discharge current for given values of anode voltage, circuit resistance and magnetic induction, or (*d*) the running voltage of the discharge for given values of the same parameters. Gases considered are argon, air and hydrogen. Use of the short cylindrical electrode arrangement previously described (2914 of 1954 and back references) has proved satisfactory. The pressure range from 10^{-1} to 10^{-8} Torr can be covered using one or more of these methods.

621.317.3 : 537.533 **849**

Automatic Instrument for Electron Scattering Measurements.—L. Marton, J. A. Simpson & T. F. McCraw. (*Rev. sci. Instrum.*, Sept. 1955, Vol. 26, No. 9, pp. 855–858.) Measurements are made of the distribution in energy and angle of electrons scattered from solids irradiated by primary electrons having energies of 10–50 keV. Energy peaks less than 20 eV apart at 20 keV and angular details of less than 10^{-2} rad can be resolved.

621.317.3 : 537.533.8 **850**

Measurement of Electron Energies by Deflection in a Uniform Electric Field.—G. A. Harrower. (*Rev. sci. Instrum.*, Sept. 1955, Vol. 26, No. 9, pp. 850–854.) The parallel-plate analyser described is designed for the study of secondary electrons having energies in the range 100–900 V, and will separate electrons differing in energy by 2%.

621.317.3 : 537.533.8.08 **851**

Apparatus for the Measurement of Secondary-Emission Coefficients.—A. Bobenrieth. (*Le Vide*, July–Sept. 1955, Vol. 10, Nos. 58/59, pp. 103–104.) Primary electrons are provided by a directly heated tantalum cathode, and the secondary electrons are collected on a screen enclosing the specimen under test. The apparatus is enclosed in a continuously evacuated glass tube from which the specimen may easily be withdrawn.

621.317.444 **852**

An Electronic Magnetometer.—B. G. Cragg. (*J. sci. Instrum.* Oct. 1955, Vol. 32, No. 10, pp. 385–386.) An electron beam deflected by the magnetic field to be measured is automatically restored by an e.s. potential which is proportional to the field for fields alternating at frequencies up to 10 kc/s. With the instrument described, the weakest field measurable is 10^{-4} oersted.

621.317.7 **853**

New Methods for the Construction of Shockproof Indicating and Recording Measurement Instruments.—T. Staub. (*Bull. schweiz. elektrotech. Ver.*, 3rd Sept. 1955, Vol. 46, No. 18, pp. 837–840, 857–860.) The most important methods for testing shock-proof instruments are described. Tensioned-strip and pivoted mechanisms are compared as regards their shock resistance, as are also 90°- and 250°-deflection instruments.

621.317.72 : 621.396.812.3 **854**

Special Instruments for Observation and Analysis of V.H.F. Fading.—K. Hirao & H. Maruyama. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 207–216.) Description of the design of equipment suitable for the autocorrelation analysis of observations of fading of v.h.f. signals due to tropospheric refractive-index variations, with a discussion of the necessary duration of observation periods and intervals between readings.

621.317.723 **855**

Vibrating-Capacitor Electrometer.—M. Brière & J. Weill. (*J. Phys. Radium*, Aug./Sept. 1955, Vol. 16, Nos. 8/9, pp. 695–703.) Detailed description of an instrument capable of detecting d.c. down to 10^{-16} A or less and having very low zero drift.

621.317.725 : 621.375.2 **856**

Wide-Range Logarithmic Voltmeter.—F. V. Hunt & J. F. Hersh. (*Rev. sci. Instrum*, Sept. 1955, Vol. 26, No. 9, pp. 829–835.) A triode valve may be made to give a logarithmic output/input characteristic by including a diode rectifier in its grid circuit, increasing input then driving the valve towards cut-off. If the a.c. input signal is divided between the biasing diode and the triode to make the response curve symmetrical several stages may be cascaded without discontinuity. In the instrument described four such stages are used; on reaching cut-off each successive valve is clamped by a diode fed from the preceding stage, and the range of the voltmeter is approximately equal to the voltage gain of the cascade amplifier. The response is independent of frequency from 50 c/s to 100 kc/s and is logarithmic over the range 1 mV to 10 V.

621.317.725.029.4 : 621.317.733 **857**

Expanded-Scale Voltmeter for A.C. Measurements.—H. Galman. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 164–165.) Use of a hot wire in a bridge circuit gives a r.m.s. indication of the voltage to be measured. This is passed through a negative-feedback amplifier to a milliammeter. By use of a tapped input transformer a range of 100–500 V is obtained with a reading accuracy within 0·25%. The instrument is independent of frequency from 50 c/s to 2 kc/s.

621.317.742 **858**

Relationship between Eccentricities and Voltage Correction Factors for Concentric Slotted Lines.—Y. Kita. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 193–199.) The voltage correction factor for coaxial-line standing-wave detectors differs from unity by $2/(1-r^2)$ times the eccentricity, where r is the ratio of the radii of the inner and outer conductors.

621.317.742 **859**

Slotted-Section Standing-Wave Meter.—E. M. Wareham. (*J. Brit. Instn Radio Engrs*, Nov. 1955, Vol. 15, No. 11, pp. 539–564.) A detailed account is given of the theory and techniques of measurement, and some results are analysed; the design of a particular instrument is discussed.

621.317.755 **860**

An Automatic Cathode-Ray-Oscilloscope Beam Brightening Device for Transient Recordings.—J. Wood. (*J. sci. Instrum*, Oct. 1955, Vol. 32, No. 10, pp. 401–402.) By slight circuit alterations to a commercially available c.r.o. a brightening pulse of 70 V is automatically applied to the grid of the tube. The time taken for the beam to reach full brilliance, after the triggering of the timebase by a transient, is brought down to about 1 μs by setting the ordinary brightness control so that the spot is just visible in the absence of a transient.

621.317.755 **861**

Large-Screen Curve Tracer.—R. Duchamp. (*Télévision*, Oct. 1955, No. 57, pp. 249–253.) Details are given of a c.r.o. using a standard 43-cm television c.r. tube with magnetic deflection. The frequency range covered is 1–250 Mc/s, with a frequency sweep variable between 1 and 40 Mc/s. The vertical scale is linear or logarithmic, and the horizontal scale is in Mc/s.

621.317.755 **862**

Sawtooth Pulser gives Voltage/Current Curves.—N. Sclar & R. L. McFolin. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 156–157.) A thyratron pulse generator with external trigger enables the voltage/current characteristics of circuit elements to be displayed on a c.r.o. The load circuit includes a series resistance small compared with that of the specimen; the voltage across this gives a measure of the current passed. Heating of the specimen is minimized by the use of a short test pulse and a low repetition rate.

621.373.421.12 **863**

Audio-Standard Generator.—P. Koustas. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 161–163.) "Simultaneous output voltages are available at frequencies of 500 c/s, 1, 1·5, 2, 3, 5 and 10 kc/s from unit employing tuning-fork standard. Technique involves full-wave rectifiers as doublers to achieve desired frequencies."

621.374 **864**

Precision Digital Delay Generator.—W. Perzley. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 148–151.) A crystal-controlled 1-Mc/s pulse generator is followed by two cascaded divide-by-ten circuits, providing three ranges of pulse frequency. The output from these is passed through a ten-stage binary counter and pulses marking any required interval are selected by flip-flop controlled diode gates. The pulse timing is independent of flip-flop transition time.

621.385.001.4 **865**

The Rating of Thermionic Valves for Use under Abnormal Ambient Conditions.—Mills & Wright. (See 937.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.767 : 621.396.96 **866**

How Accurate are Radar Speed Meters?—J. Q. Brantley, Jr. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 132–134.) Tests on a type of motor-vehicle speed meter depending on the measurement of the Doppler shift in reflected signal frequency are described. Most of the possible errors are shown to result in speed indications which are too low.

539.32 : 534.2-8 **867**

Measurement of the Elastic Constants of Solids, using Ultrasonics.—G. Mayer & J. Gigon. (*J. Phys. Radium*, Aug./Sept. 1955, Vol. 16, Nos. 8/9, pp. 704–706.) A cylinder of the material under test is suspended in an ultrasonic field of continuously variable frequency, produced by an ionophone; the frequency is varied until the specimen resonates, this condition being detected e.g. by arranging a graphite or Ge point in light contact with the specimen and completing the circuit.

621-52 **868**

Automation—a Survey.—R. J. Bibbero. (*Elect. Engng, N.Y.*, Sept. 1955, Vol. 74, No. 9, pp. 775–780.) Historical and current aspects of development are discussed generally.

621.317.083.7(47) : 016 **869**

List of Russian and Translated Literature on Telemetering for 1950–1954.—V. P. Demeshin, I. A. Kostetskaya, A. I. Novikov, N. V. Pozin & V. A. Kashirin. (*Avtomatika i Telemekhanika*, July/Aug. 1955, Vol. 16, No. 4, pp. 409–410.)

621.317.39 **870**

Ice Detector for Lighter-than-Air Craft.—E. G. Thurston. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 142–144.) A piezoelectric Meacham-bridge oscillator system is used to determine the amount of ice or other deposit on the surface of balloons, etc., by cementing the piezoelectric element to the inside surface of the fabric so that the ice formation adds to its effective mass.

621.383.2 : 535.376 **871**

Realizable Light Gain in Photoelectronic Image Intensifiers.—L. Mandel. (*J. sci. Instrum.*, Oct. 1955, Vol. 32, No. 10, pp. 405–406.) By combining the most efficient photoelectric and luminescent surfaces an effective light gain of the order of 100 should be realizable. For photographic purposes two intensifiers in cascade, with optical focusing of the beam incident on each photocathode and on the photographic plate, should give a gain of about 115, with possibilities of further improvement.

621.384.6 **872**

Radiation Damping in Particle Accelerators with Circular Focusing Guiding Field.—W. Humbach. (*Z. Naturf.*, April 1955, Vol. 10a, No. 4, pp. 347–348.)

621.384.611/.612 **873**

The Extraction of the Beam from the Liverpool Synchrocyclotron.—(*Proc. roy. Soc. A*, 25th Oct. 1955, Vol. 232, No. 1189, pp. 236–251.)

Part 1—Theoretical.—K. J. Le Couteur (pp. 236–241). The beam is extracted by a magnetic deflector designed to produce radially unstable orbits while maintaining vertical stability; the theoretical specification of the apparatus is given.

Part 2—Experimental Work.—A. V. Crewe & J. W. G. Gregory (pp. 242–251). In the final result, 3% of the circulating beam was extracted from the cyclotron tank. The beam energy is 383 MeV, with no measurable energy spread. By means of an auxiliary magnet the beam has been focused to give a spot in which the proton flux density is at least 1 000 times greater than that obtained from any similar machine.

621.384.612 **874**

Three-Hundred-MeV Nonferromagnetic Electron Synchrotron.—W. B. Jones, H. R. Kratz, J. L. Lawson D. H. Miller, R. D. Miller, G. L. Ragan, J. Rouvina & H. G. Voorhies. (*Rev. sci. Instrum.*, Sept. 1955, Vol. 26, No. 9, pp. 809–826.) Description of an instrument in which electrons are injected at an energy of 100 keV, accelerated to 4 MeV by betatron action and then to 300 MeV by synchrotron action. The magnetic guiding fields for the betatron and synchrotron operation are produced by suitable coils.

621.384.612 **875**

The Accuracy of Alignment required for a Strong-Focusing Synchrotron.—W. Humbach. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 423–427.) Analysis for an alternating-gradient synchrotron shows that a statistical distribution of alignment errors causes the particles to diffuse from the prescribed orbit; the tolerances on alignment are governed by the permissible loss of particles due to this diffusion.

621.384.613 **876**

A 20-MeV Betatron for X-Ray Therapy.—D. Major, F. R. Perry & K. Phillips. (*Proc. Instn elect. Engrs*, Part A, Dec. 1955, Vol. 102, No. 6, pp. 845–856.) Full description of equipment installed at Manchester.

621.384.613 : 620.179.1 **877**

A 15-MeV Betatron for the Nondestructive Testing of Materials.—R. Schittenhelm. (*Arch. tech. Messen*, Sept., Oct. & Dec. 1955, Nos. 236, 237 & 239, pp. 205–208, 225–228 & 275–276.) Design details are given; emphasis is on low magnet weight and high electron-beam intensity.

621.384.622 **878**

Linear Acceleration of Charged Particles to High Energies.—C. W. Miller. (*Engineering, Lond.*, 9th & 16th Sept. 1955, Vol. 180, Nos. 4676 & 4677, pp. 340–343 & 374–377; *Metrop. Vick. Gaz.*, Dec. 1955, Vol. 26, No. 437, pp. 373–387.) An account is given of the development of linear accelerators, some post-war models are described and possible applications are reviewed. 45 references.

621.384.622.2 **879**

45-MeV Medical Linear Electron Accelerator.—C. L. Hsieh. (*Elect. Engng, N.Y.*, Sept. 1955, Vol. 74, No. 9, pp. 790–795.) Detailed description of a machine developed for a Chicago hospital.

621.385.833 **880**

The Field Distribution in Asymmetrical Magnetic Electron Lenses.—G. Liebmann. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 679–681.) The problem was investigated by the resistance-network analogue method (1954 of 1950). A series of typical characteristic curves is given.

621.385.833 **881**

The Magnetic Pinhole Electron Lens.—G. Liebmann. (*Proc. phys. Soc.*, 1st Sept. 1955, Vol. 68, No. 429B, pp. 682–685.) An asymmetrical lens is considered with bore radii R_0 and R_1, where R_1 is very small compared with R_0. The focal length is not greatly altered, but the spherical aberration may be considerably increased by the presence of the pinhole.

621.385.833 **882**

A Unified Representation of Magnetic Electron Lens Properties.—G. Liebmann. (*Proc. phys. Soc.*, 1st Oct. 1955, Vol. 68, No. 430B, pp. 737–745.) It is shown that many magnetic electron lenses, both symmetrical and asymmetrical, can be represented by a single focusing curve.

621.385.833 **883**

Experimental Investigation of Chromatic Aberration in the Electron Microscope.—S. Katagiri. (*Rev. sci. Instrum.*, Sept. 1955, Vol. 26, No. 9, pp. 870–873.) Experimental results indicate that chromatic field aberration can be completely compensated by a proper combination of two magnetic lenses. Micrographs with a resolution of about 5 mμ can be obtained with accelerating-voltage fluctuations as great as 1%.

621.385.833 **884**

On Electron Mirror Microscopy.—L. Mayer. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1228–1230.) A brief indication is given of the potentialities of electron-microscope systems in which the field in front of the specimen reflects the exploring beam. A resolving power comparable to that of the optical microscope has been obtained.

621.387.424 **885**

Behaviour of Externally Graphited Glass-Walled Geiger-Müller Counters exposed to Intense γ Radiation.—D. Blanc. (*J. Phys. Radium*, Aug./Sept. 1955, Vol. 16, Nos. 8/9, pp. 681–687.)

621.387.464 **886**

The Physics of the Scintillation Counter.—G. F. J. Garlick. (*J. sci. Instrum.*, Oct. 1955, Vol. 32, No. 10, pp. 369–371.) Factors limiting the performance of scintillation counters used as energy spectrometers are discussed. Spread in output-pulse magnitude when detecting mono-energetic particles results from statistical fluctuations in the photomultiplier cathode; in practice other variables can also contribute. The problem of non-linear variation of phosphor response is treated.

621.387.464 **887**

Problems of Large-Area Scintillation Counters.—F. X. Roser. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 297–323.) The various, sometimes conflicting, requirements for optimum resolving power are discussed. A method involving masking of the central region of the photomultiplier cathode has given good results. 102 references.

621.387.464 **888**

Portable Scintillation Counter for Applications in Geology.—H. Schneider. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 413–416.) The probe unit of the instrument described comprises a NaI/Tl crystal of diameter 30 mm and thickness 15–20 mm in combination with a German Type-FS9-A photomultiplier; the amplifier, batteries, etc. are in a separate case. Sensitivity is ten times that of a G-M counter with the same active area.

771.36 : [621.383.2 + 621.317.755 **889**

A [camera-] **Shutter Tester using a Photoelectric Integrator.**—R. J. Hercock & D. M. Neale. (*J. Brit. Instn Radio Engrs*, Nov. 1955, Vol. 15, No. 11, pp. 565–575.) An instrument comprising a photoelectric integrator together with a single-sweep c.r.o. is described.

534-8 : 62 **890**

Ultrasonic Engineering. [Book Review]—A. E. Crawford. Publishers: Butterworths Scientific Publications, London, 344 pp., 45s. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 355–356.) "... should prove of considerable help to the acoustics engineers interested in the effects and applications of ultrasonic waves."

PROPAGATION OF WAVES

621.396.11 **891**

Ground-Wave Propagation over a Nonhomogeneous Earth.—K. Venkitaraman. (*J. Instn Telecommun. Engrs, India*, Sept. 1955, Vol. 1, No. 3, pp. 155–171.) The relative merits of known methods of calculating the ground-wave field strength are assessed by reference to measurement results. The superiority of Millington's method is confirmed.

621.396.11 : 551.510.535 **892**

The Physics of the Ionosphere.—(See 755.)

621.396.11 : 551.510.535 **893**

The Influence on the Recordings of Ionosphere E-Layer Soundings of the Separation Level of Regions of Quasi-longitudinal (Q.L.) and Quasi-transverse (Q.T.) Propagation.—D. Lepechinsky. (*C. R. Acad. Sci., Paris*, 3rd Oct. 1955, Vol. 241, No. 14, pp. 897–900.) Continuation of previous discussion [1767 of 1955 (Lepechinsky & Durand)]. Conditions are

considered for the four cases when the E-layer maximum-ionization level is (*a*) above, (*b*) coincident with, (*c*) a little below, and (*d*) considerably below the separation level. An indication is given of the nature of the $h'f$ traces to be expected and of the significance of the various conditions for the evaluation of the maximum E-layer ionization from the f_0 value. Recordings made at Poitiers are reproduced showing absence of trace corresponding to case *b* and the inflection point corresponding to case *c*.

621.396.11 : 551.510.535 **894**

Characteristics of F_2-Layer Multiple Reflections (10–16 Times).—Y. Echizenya, S. Katano & Y. Ogata. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 137–141.) Routine vertical-incidence ionospheric soundings during 1953 and 1954 show that high-order multiple reflections occur only at night and are confined to the ordinary ray. The frequency of occurrence of the phenomenon is high in spring and autumn and low in summer and winter and shows marked correlation with the noon value of f_0F_2.

621.396.11 : 551.510.535 **895**

Magneto-ionic Triple Splitting over Delhi.—S. N. Mitra. (*J. Instn. Telecommun. Engrs, India*, Sept. 1955, Vol. 1, No. 3, pp. 124–129.) Records of triple splitting obtained on six occasions between 1951 and 1955 are discussed with particular reference to the low geomagnetic latitude of Delhi. The splitting may be caused by longitudinal propagation of the ordinary ray, associated with an increase in the collision frequency in the ionosphere.

621.396.11 : 551.510.535 **896**

Observations of Short-Wave Back-Scatter with Commercial Telegraphy Signals.—B. Beckmann & K. Vogt. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, pp. 473–481.) Observations were made using the 'ring' method, in which the back-scattered signal is transposed to i.f. and applied with 90° phase difference to the vertical and horizontal plates of a c.r.o. so that signal amplitudes are displayed as rings. Results show that the azimuthal distribution of back-scatter is governed by ionospheric conditions and by the radiation patterns of the transmitting aerial; when a directional aerial is used the main direction from which energy is received is that theoretically expected. The back-scatter mainly uses the great-circle path. The time variation of the back-scatter intensity agrees with that for ordinary propagation in the same wave-band. Determinations of the dead zone can be made from the variation of back-scatter transmission time with frequency.

621.396.11.029.62 **897**

On the Relationship between the Hourly Variation of Field Strength and the Structure of the Lower Atmosphere.—K. Tao. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 181–191.) Field-strength observations made on 60-Mc/s signals transmitted over a distance of 125 km are correlated with meteorological data.

621.396.11.029.63/.64 **898**

Experimental Studies on Diffracted Waves from a Mountain at 3 000 Mc/s.—T. Kono, K. Nishikori, M. Fukushima, M. Ikeda & N. Yoshida. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 163–180.) Continuous photographic records were made of the reception of pulsed transmissions over distances of 234 km and 166 km across a mountain 1 000 m high. The measurements were made in September and December 1954, respectively. For the first path, with the receiving station situated 90 km beyond the mountain, the observed field strength agreed approximately with that calculated by Fresnel's knife-edge-diffraction theory; for the second path, with the receiver 35 km beyond the mountain, the field strength was about 10 dB below the calculated value.

621.396.11.029.64 : 621.396.96 : 551.578.4 **899**

The Back-Scattering Coefficient of a Spherical Homogeneous Mixture of Ice and Air at Wavelengths between 1 and 10 Centimeters.—J. C. Johnson. (*J. Met.*, April 1955, Vol. 12, No. 2, pp. 188–189.)

621.396.812.3 : 551.510.535 **900**

Three Components of the Field Strength of the Wave reflected from the Surface of the Ionosphere, their Level and Time Variation.—H. Uyeda, Y. Ogata, K. Uchikura, Y. Arima & H. Obayashi. (*J. Radio Res. Labs, Japan*, April 1955, Vol. 2, No. 8, pp. 143–161.) Tentative theory is developed to account for observed variations in received field strength of 4-Mc/s signals. Formulae are derived for various configurations of the ionospheric reflecting surfaces, considered (*a*) at rest and (*b*) moving with constant horizontal velocity.

621.396.812.3 : 621.317.72 **901**

Special Instruments for Observation and Analysis of V.H.F. Fading.—Hirao & Maruyama. (See 854.)

RECEPTION

621.374 **902**

Frequency of Coincidence of Two Sets of Recurrent Pulses.—H. Rakshit & S. C. Mukherjee. (*J. Instn Telecommun. Engrs, India*, Sept. 1955, Vol. 1, No. 3, pp. 130–135.) Conditions are analysed for narrow and for broad pulses.

621.396.62 : 621.372.543.2 : 621.396.822 **903**

Bandwidths of Various Filter Circuits and C.C.I.R. Recommendations on Effective Noise Bandwidths.—E. Henze. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, pp. 512–515.) According to the C.C.I.R. recommendation, effective noise bandwidth of receivers is the width of a rectangle having the same area as the actual selectivity curve. The ratio of the effective noise bandwidth to the actual bandwidth is calculated for several practical selective circuits.

621.396.621 : 621.396.822 **904**

The Effect of a Random Noise Background upon the Detection of a Sinusoidal Signal.—H. S. Heaps. (*Canad. J. Phys.*, Sept. 1955, Vol. 33, No. 9, pp. 509–520.) Analysis is presented for the case when the signal envelope exhibits negligible fluctuations. The effect of large signal fluctuations is demonstrated by comparing these results with those obtained previously (2099 of 1955).

621.396.82 : 551.594.6 : 621.317.3 **905**

Atmospheric Noise Interference to Broadcasting in the 5-Mc/s Band at Poona.—K. R. Phadke. (*J. Instn Telecommun. Engrs, India*, Sept. 1955, Vol. 1, No. 3, pp. 136–146.) Measurements of atmospheric noise interference were made during the hours 1800–2300 I.S.T., using Aiya's method (257 of 1955). The results are used to discuss noise values for satisfactory broadcasting service, in comparison with Radio Research Board and Central Radio Propagation Laboratory estimates. Noise levels estimated from lightning-discharge data [3263 of 1955 (Aiya)] are in close agreement with the measured values.

621.396.828 **906**

Reducing Radio Interference.—(*Elect. Times*, 8th Sept. 1955, Vol. 128, No. 3331, p. 352.) Note on a new Code of Practice CP 1006:1955, published by the British Standards Institution, on the general aspects of radio-interference suppression in the medium- and long-wave

bands as well as the 41–61-Mc/s television band. Requirements and tests for suppressor components and complete filter units are covered by the revised British Standard 613:1955.

STATIONS AND COMMUNICATION SYSTEMS

621.39.001.1 **907**

Theory of Pre-correction of Transmission Errors.—B. Mandelbrot. (*Ann. Télécommun.*, June 1955, Vol. 10, No. 6, pp. 122–134.) Feinstein's theorem (858 of 1955) is discussed and practical methods of pre-correction are derived.

621.395.44 : 621.315.212 **908**

Coaxial-Cable Carrier-Current Systems.—J. Bauer & J. Valloton. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Sept. 1955, Vol. 33, No. 9, pp. 337–368. In German and French.) Detailed description of the Swiss system providing 960 telephony channels in the frequency band 60 kc/s–4·028 Mc/s.

621.396.1 **909**

Future of European Broadcasting.—G. H. Russell. (*Wireless World*, Jan. 1956, Vol. 62, No. 1, pp. 18–22.) Failures of the Copenhagen plan (832 of 1949) are discussed and a suggested new plan is outlined providing 15 long-wave channels between 150 and 285 kc/s and 121 medium-wave channels in four bands between 525 kc/s and 1·602 Mc/s. Total power would be allocated to each country on an area basis.

621.396.41 : 551.510.52 **910**

Designing Over-Horizon Communications Links.—D. Davidson & A. J. Poté. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 126–131.) Existing knowledge on long-range tropospheric propagation is summarized, with references to original papers, and the design considerations necessary to achieve a system having a given reliability are discussed. See also 263 of January (Mellen et al.).

SUBSIDIARY APPARATUS

621-526 : 621.372.5 **911**

The Response Functions and Vector Loci of First and Second Order Systems.—Morris. (See 690.)

621.311.6 : 621.314.67 **912**

Reliable Power-Pack Design.—A. F. Standing. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 532–535.) "A method is described which reduces the design of capacitor-input power packs to simple calculations aided by graphs."

621.316.722 : [621.375.23 + 621.373.421 **913**

A Constant-Voltage Amplifier and Oscillator.—G. N. Patchett. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 536–539.) The equipment is based on the use of a thermistor bridge to regulate feedback and was designed for a frequency of 1 kc/s. The amplifier output voltage is constant to within 0·1% for an input-voltage range of 0–4 V, with load varying from zero to 10 W or supply voltage varying from 130 to 250 V. Used as an oscillator, the equipment gives an output-frequency change of 1 c/s for a supply-voltage change from 180 to 250 V when operating on full load, and < 3 c/s for maximum load variation at a given supply voltage.

621.318.435 : 621.316.722.076.25 : 621.372.54 **914**

Stabilization of Random Voltage Fluctuations by Ferroresonant [saturated-choke] **Stabilizer.**—A. N. Malakhov. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, July 1955, No. 7, pp. 3–8. In Russian.) An investigation is reported of the transfer of voltage fluctuations by a stabilizer comprising an air-cored choke (L), in series with the input, and a saturated choke (D) in parallel with the load. The calculated and experimentally determined transfer-coefficient frequency characteristics presented in figs 3 and 4, respectively, show (*a*) that there is a maximum at a frequency $\Omega_0 < \omega$, where ω is the supply frequency, and (*b*) that the attenuation is high only for fluctuations with angular frequency $\Omega \ll \Omega_0$.

621.319.339 **915**

High-Voltage Generator of van de Graaff Type with Liquid Charge Carrier.—K. Janner, S. Magun & E. Schopper. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 446–450.)

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 : 621.375.2 **916**

The 'Chasseral'-Type Video Distribution Amplifier.—H. A. Lactt. (*Tech. Mitt. schweiz. Telegr.-Teleph-Verw.*, 1st Sept. 1955, Vol. 33, No. 9, pp. 369–374. In German and French.) The amplifier is designed to suit both 75-Ω and 150-Ω coaxial cable; the bandwidth is 10 Mc/s and the overall gain is unity with a reserve of 10 dB. Low-frequency equalization is effected by a series combination of integrating and differentiating RC networks. There are two separate feedback loops, one with a level frequency response and the other with a rising frequency response. Four parallel output stages are provided, using pentodes with negative current fecdback.

621.397.5 : 535.623 **917**

Colour Television—B.B.C. Experiments.—(*J. Brit. Instn Radio Engrs*, Nov. 1955, Vol. 15, No. 11, pp. 576–581.) Details are given of the equipment and modified N.T.S.C. signal used.

621.397.5 : 778.5 **918**

The Suppressed-Frame System of Telerecording.—C. B. B. Wood, E. R. Rout, A. V. Lord & R. F. Vigurs. (*B.B.C. Engng Div. Monographs*, No. 1, pp. 1–14.) Description of apparatus comprising a high-grade television monitor [1753 of 1953 (Lord & Wood)] together with a commercially available 35-mm motion-picture camera.

621.397.5 : 778.5 **919**

16-mm Telerecording for Sequential Television Systems.—V. B. Hulme. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 516–522.) "A system of telerecording using continuous film motion through a shutterless gate is described. The camera motor speed is controlled by means of negative feedback components of phase, velocity and acceleration. A d.c. generator and pulse generator driven by the motor together with a phase-discriminator provide these components in the form of voltages." The picture is presented line by line on the screen of the c.r. tube, the frame scan being eliminated.

621.397.5(083.74) **920**

Television Waveform.—(*Wireless World*, Jan. 1956, Vol. 62, No. 1, p. 26.) The black level in the British 405-line waveform has been lifted by 5% of peak white amplitude and the suppression period preceding the synchronizing signal has been lengthened by 0·5 μs compared with the previous standards (2912 of 1952).

621.397.5(494) : 621.396.11 **921**

Television in Switzerland.—(*Wireless World*, Jan. 1956, Vol. 62, No. 1, pp. 33–35.) Service to thickly populated areas is provided by three stations working on frequencies in band I and a fourth using band III. The stations are sited at altitudes of 2 000–5 000 ft and the

mean height of towns served is about half that of the corresponding transmitter. The transmitters are linked by a radio-relay system working on 2 kMc/s. A map shows the effective coverage of one of the transmitters. See also 277 of 1955 (Gerber).

TRANSMISSION

621.396.61 : 621.372.54 **922**

High-Frequency Filters and Tuning of Amplitude-Modulated Transmitters.—R. Guertler. (*Telefunken Ztg*, June 1955, Vol. 28, No. 108, pp. 116–123. English summary, pp. 134–135.) Transmitter output stages are discussed comprising coupled tuned circuits of which the primary one, in the output-valve anode circuit, is parallel resonant while the secondary is series resonant. A frequency response symmetrical with respect to carrier frequency, and hence absence of unwanted phase modulation, is attained by adjusting the secondary rather than the primary circuit to make the anode impedance purely resistive. Locus diagrams indicate the circuit operation.

VALVES AND THERMIONICS

621.314.63 : 546.28 **923**

Zener-Voltage Breakdown Uses in Silicon Diodes.—C. N. Wulfsberg. (*Electronics*, Dec. 1955, Vol. 28, No. 12, pp. 182..192.) For back voltages less than the Zener voltage the back resistance of a Si junction diode may exceed $10^{10}\,\Omega$. The Zener voltage may be made to have any value from 3 V to several hundred volts. A wide variety of applications is discussed.

621.314.7 **924**

Junction Transistor Electronics.—J. L. Moll. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1807–1819.) A review paper. The mechanism of current transport at semiconductor junctions is described and parameters of junction transistors are hence derived. Amplifying, oscillating and switching performance is discussed. Replacement rates as low as one per 20 000 transistor-hours are reported.

621.314.7 **925**

Temperature Variation of the 'Punch-Through' Voltage of a Transistor.—O. Garreta. (*C. R. Acad. Sci., Paris*, 3rd Oct. 1955, Vol. 241, No. 14, pp. 857–859.) The variation of the 'punch-through' voltage [3329 of 1953 (Dacey)] over the temperature range 14°–300°K was studied for *p-n-p* transistors. The potential distribution through the transistor exhibits its maximum value at a point within the base distant x_m from the emitter junction, where $x_m = T^{\frac{1}{2}}\phi(z_m)$ and z_m is a dimensionless parameter. A formula is derived indicating that the value of the punch-through voltage at any temperature is equal to the value at zero temperature less a term proportional to x_m. This formula is verified by experimental results on three Ge transistors. By extrapolating to zero temperature the thickness of the base can be determined exactly.

621.314.7 : 546.28 **926**

Recent Developments in Silicon Fusion Transistors.—R. A. Gudmundsen, W. P. Waters, A. L. Wannlund & W. V. Wright. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. ED-2, No. 1, pp. 74–81.)

621.314.7 : 621.375.4 **927**

Some Properties and Circuit Applications of Super-Alpha Composite Transistors.—A. R. Pearlman. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. ED-2, No. 1, pp. 25–43.) Circuits are discussed in which two junction transistors are interconnected in such a way that the gain of the combination is increased; α values $> 0{\cdot}99$ can be achieved. The properties of such arrangements are in many ways equivalent to those of a vacuum triode. Voltage-follower and voltage-amplifier circuits using composite transistors are described. Characteristics of two- and three-stage composite transistors are shown graphically.

621.314.7 : 621.375.4 **928**

The Equations and the Equivalent Circuit of the Transistor.—M. Skalicky. (*Elektrotech. u. Maschinenb.*, 1st Sept. 1955, Vol. 72, No. 17, pp. 422–423.) Analysis leads to the development of a passive-quadripole representation of the transistor.

621.383.27 : 621.396.822 **929**

Hysteresis Effect in Multiplier Phototube Noise.—C. A. Ziegler & H. H. Seliger. (*J. appl. Phys.*, Oct. 1955, Vol. 26, No. 10, pp. 1225–1227.) Measurements of the variation of noise with time and with operating parameters are reported for two types of photomultiplier. Possible explanations of the observed effects are discussed.

621.383.27.032.21 **930**

Dark Current of Secondary-Electron Multipliers with (Ag)-Cs_2O, Cs-Ag Photocathodes.—E. Eckart. (*Ann. Phys., Lpz.*, 20th Sept. 1955, Vol. 16, Nos. 5/8, pp. 322–330.) The temperature dependence of the thermionic emission of the cathode was investigated over the temperature range of about 20°C–40°C. At 19·7°C the dark current at the anode was $3{\cdot}2 \times 10^{-8}$ A with an amplification of $1{\cdot}4 \times 10^{6}$; this corresponds to a thermionic emission of 10^{-15} A cm^{-2}. The work function, calculated from the specific-emission/reciprocal-temperature curve, is 0·95 eV, that calculated from the cut-off frequency of the external photoeffect is 1·06 eV. The construction and manufacture of the photomultiplier is described in detail.

621.383.4 : 535.37 : 621.318.57 **931**

Opto-electronic Devices and Networks.—E. E. Loebner. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1897–1906.) "The transducing properties of electroluminescent and photo-responsive cells are described. The light amplifying and spectrum-converting characteristics of a circuit consisting of an electric power supply and a series combination of the two types of cells whose impedances have been matched are discussed. The construction and operation of an opto-electronic bistable device—the 'optron'—employing positive radiation feedback, is reported. The optron is both a storage cell and a switch with dual (optical and electrical) signal input and output. Numerous logic networks, composed of electric series and parallel combinations of electroluminescent and photoconductive cells with selected optical couplings have been designed, constructed, and operated."

621.383.4 : 535.371.07 **932**

Theory and Experiments on a Basic Element of a Storage Light Amplifier.—J. E. Rosenthal. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1882–1888.) Theory is developed to explain the operation of solid-state image intensifiers of the type described e.g. by Orthuber & Ullery (3061 of 1954), in which a layer of a photoconductor such as CdS is used to control the voltage across an electroluminescent element. Optimum values of operating parameters deduced are in good agreement with experimental results.

621.383.4 : 535.371.07 **933**

An Electroluminescent Light-Amplifying Picture Panel.—B. Kazan & F. H. Nicoll. (*Proc. Inst. Radio Engrs*, Dec. 1955, Vol. 43, No. 12, pp. 1888–1897.) The construction of large-area solid-state image intensifiers of the general type described by Orthuber & Ullery (3061 of 1954) is made feasible by providing the photoconductive CdS in powder form [612 of February (Nicoll

& Kazan)]; the powder may be supported on a mesh or laid in grooves. Using an excitation frequency of e.g. 400 c/s, good resolution of half-tone pictures has been obtained with panels 12 in. square. Response time is 0·1 sec or more; other photoconductive materials may be found to give quicker response.

621.383.4 : 537.311.33 : 535.215 **934**

Lead Salt Photoconductors.—Moss. (See 773.)

621.383.5 : [621.314.63 + 621.314.7 **935**

Photodiodes and Phototransistors considered as Infrared-Radiation Detectors.—G. A. Boutry & F. Desvignes. (*Nuovo Cim.*, 1955, Supplement to Vol. 2, No. 3, pp. 541–563. In French.) A comprehensive survey with 59 references.

621.385 **936**

Some Factors affecting Transmitting Valve Life.—T. N. Basnett. (*J. Brit. Instn Radio Engrs*, Nov. 1955, Vol. 15, No. 11, pp. 588–592.) Reprint. See 3717 of 1954.

621.385.001.4 **937**

The Rating of Thermionic Valves for Use under Abnormal Ambient Conditions.—B. D. Mills & W. W. Wright. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 276–292.) Manufacturers' published ratings may need revision if valves are to be operated in either very high or very low ambient temperatures. An interim report is presented of a program of life tests designed to determine suitable maximum temperatures for various types of valve. The procedure adopted is to set the ambient conditions as desired and to measure the 'hot-spot' bulb temperatures for a range of input anode powers. Results are presented graphically, the variables being the total input power, the 'hot-spot' temperature, the ambient temperature, and the equivalent altitude. Simple tests can give enough information to evolve a whole family of rating curves.

621.385.029.6 **938**

Theory of the Pre-oscillating Magnetron: Part 2—Perturbations of a Double-Stream Steady State.—G. D. Sims & D. Gabor. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 231–262.) An attempt is made to determine theoretically the dispersion relation for oscillations in a cut-off magnetron on the assumption of a double stream in the steady state, and of a particular distribution of electron velocities. A perturbation method is used; the electron density of the perturbed cloud is deduced for the case of a finite cathode temperature. The implications of the results in relation to magnetron starting, back-bombardment and noise spectrum are discussed. Part 1: 3787 of 1955 (Gabor & Sims).

621.385.029.6 **939**

Comments on Magnetron Theory, with Particular Reference to some Recent Publications.—O. Buneman. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 314–323.) Recently published papers are criticized as being unduly preoccupied with symmetrical steady states and indicating possible ignorance of wartime development work on magnetrons. The question is posed, whether the magnetron is worth the intense theoretical effort required to solve the problems involved.

621.385.029.6 : 537.533 **940**

Energy Distribution of Electrons in Beams with Strong Space Charge.—W. Veith. (*Z. angew. Phys.*, Sept. 1955, Vol. 7, No. 9, pp. 437–443.) Experiments with specially constructed travelling-wave valves show that if the beam is retarded between the end of the helix and the collector electrode the range of electron energies is very greatly extended. The effect is attributed to a redistribution of energy occurring as the beam traverses the retarding path; the extra-high energy values increase with increasing length of the retarding path. The explanation is relevant also to phenomena observed with hollow cathodes.

621.385.029.6 : 537.533 : 621.386 **941**

An X-Ray Method for studying Radial Current Distributions in Electron Beams.—J. S. Thorp. (*Brit. J. appl. Phys.*, Oct. 1955, Vol. 6, No. 10, pp. 366–368.) The cathode producing the beam to be studied is mounted in a valve whose anode is a thin foil forming part of the envelope. Soft X rays, generated by the impact of electrons on the foil, are transmitted and produce an image of the transverse section of the beam on a photographic film pressed against the outer surface of the foil. The method has applications in the development of klystrons, etc.

621.385.029.6 : 621.372.2 **942**

Propagation in Linear Arrays of Parallel Wires.—J. R. Pierce. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. ED-2, No. 1, pp. 13–24.) Analysis is presented for propagation in periodic structures incorporating transverse wires, of the general type used in the travelling-wave valves discussed by Leblond & Mourier (1204 of 1955) and Karp (1212 of 1955).

621.385.029.6 : 621.386 **943**

X-Ray Production by Magnetron.—A. C. Wesley. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, p. 29.) Incidental production of soft X rays by a Type-4J50 magnetron has been observed. A bend should be included in waveguide systems used with the magnetron, to act as an X-ray filter.

621.385.029.64 **944**

The Design and Performance of a High-Power Demountable Klystron Amplifier for X-Band.—J. D. Lawson, R. S. Barton, T. F. Gubbins, W. Millar & P. S. Rogers. (*J. Electronics*, Nov. 1955, Vol. 1, No. 3, pp. 333–354.) The design of a two-cavity klystron to give c.w. power of 1 kW and a gain of 10 at 9·375 kMc/s is discussed. Constructional techniques are described in detail. Performance is in fair agreement with basic theoretical predictions, except as regards the gain.

621.385.032.216 **945**

Thermionic Emission from Sintered Mixtures of Powdered Tungsten with Alkaline-Earth Carbonates.—G. Mesnard & R. Uzan. (*Le Vide*, July–Sept. 1955, Vol. 10, Nos. 58/59, pp. 105–118.) The chemical reactions occurring during the heat treatment of cathodes formed from mixtures of powdered refractory metals with emissive powders are discussed; emissivity/temperature curves for various mixtures are given. The cathodes considered are superior to the usual types as regards sensitiveness to the presence of gas and ionic bombardment, and they can readily be reactivated. See also 3728 of 1954 (Uzan & Mesnard), etc.

621.385.032.216 **946**

The Effect of Zirconium on Sintered Alkaline-Earth Oxide Cathodes.—G. Mesnard & R. Uzan. (*Le Vide*, July–Sept. 1955, Vol. 10, Nos. 58/59, pp. 124–134.) The addition of Zr as a reducing agent to the mixtures used in the formation of sintered cathodes is shown to have harmful effects on the emissivity. Heat treatment in an atmosphere of hydrogen gives bad results, favouring oxidation of the metals present. Amongst possible alternatives, the use of Ni gives best results. See also 3728 of 1954 (Uzan & Mesnard), etc.

621.385.2 : 621.396.822 **947**

The Rise of Noise Temperature in Space-Charge-Limited Diodes.—H. W. König. (*Arch. elekt. Übertragung*, Sept. 1955, Vol. 9, No. 9, pp. 411–418.) Continuation of previous discussion (2794 of 1955). Calculations made taking account of electron-velocity fluctuations at the cathode and of the correlation between velocity and current fluctuations give results in improved agreement with observations. Very small irregularities in cathode structure may cause a reduction of the space-charge factor of several thousandths below the ideal value of unity, leading to a very large rise of noise temperature with increasing anode voltage. The theory presented enables the imaginary part of the correlation factor to be determined from experiments.

621.385.2.029.6 **948**

Electron Trajectories in Coaxial Diodes.—R. Dehn. (*Wireless Engr*, Jan. 1956, Vol. 33, No. 1, pp. 10–12.) Calculations have been made for diodes in which the electron transit time corresponds to several cycles at 3 kMc/s. Depending on the r.f. phase at which they are emitted, electrons may proceed to the anode or may return to the cathode either within a single r.f. cycle or in the course of several r.f. cycles. Experimental results indicate that the numbers of electrons reaching the anode and returning to the cathode are about equal.

621.385.832 **949**

A Theory of determining the Dynamic Sensitivity of Cathode-Ray Tubes at Very High Frequencies by Means of Fourier Transforms.—E. F. Bolinder. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. ED-2, No. 1, pp. 44–50.)

621.385.832.032.2 **950**

The Electron Gun of the Cathode-Ray Tube—Tetrode or Triode?—J. A. Darbyshire. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 523–528.) The triode gun gives a smaller spot at the centre of the screen and is therefore preferable for some applications, but for television purposes the tetrode gun is better since it has a narrower beam width in the region of the scan coils and hence better deflection defocusing characteristics, together with lower cathode loading.

621.387 **951**

Initiation of Hot-Cathode Discharges.—N. R. Daly & K. G. Emeleus. (*Brit. J. appl. Phys.*, Oct. 1955, Vol. 6, No. 10, pp. 370–372.) Report of an experimental study of the effect of a voltage fall along a hot cathode on the initiation of a gas discharge in a diode at low pressure. Observations were made of the appearance of the discharge before and after the formation of plasma, and of the oscillations generated by the discharge.

621.387 **952**

Running-Voltage/Current Characteristics of some Glow-Discharge Tubes.—F. A. Benson & G. Mayo. (*Electronic Engng*, Dec. 1955, Vol. 27, No. 334, pp. 540–542.) Conclusions arrived at in a previous paper (3422 of 1954) concerning the important influence of the gas filling on the running-voltage/ambient-temperature characteristics of glow-discharge tubes are shown to apply also to running-voltage/current characteristics. Running-voltage drift and hysteresis effects also vary with the kind of gas used.

621.387 : 621.318.57 **953**

Response Times of Gas-Filled Valves for Switching Purposes in Communication Engineering.—K. Braun. (*Fernmeldetech. Z.*, Sept. 1955, Vol. 8, No. 9, pp. 490–493.) Equipment for measuring firing time is described. For a coincidence thyratron with anode voltage 60 V and grid overvoltage 1 V, a value of 10 μs was found; for some cold-cathode triodes with anode voltage 180–250 V and starter overvoltage 5–10 V the value was 100 μs.

621.387 : 621.385.3 **954**

Amplifier Action of Gas-Filled Triodes.—A. Székely. (*Acta phys. austriaca*, Aug. 1955, Vol. 9, Nos. 3/4, pp. 258–266.) Continuation of experiments reported previously (599 of 1954). If it is assumed that the internal resistance of the gas-filled triode is determined by the resistance of the positive space-charge layer around the grid, the amplifier action can be described by means of the Barkhausen formula for the vacuum triode and the dependence of the amplification on the frequency and amplitude of the grid voltage and on the intensity of the auxiliary grid-anode discharge can be explained. High gain is obtainable only for frequencies below about 150 kc/s. Gain is constant only for grid alternating voltages below about 0·5–1 V; the value for the Type-4690 valve used is 44.

MISCELLANEOUS

061.3 : [55 + 621.396.11] **955**

The XIth General Assembly of the International Scientific Radio Union (U.R.S.I.), held at The Hague, 1954.—(*Onde élect.*, June 1955, Vol. 35, No. 339, pp. 555–629.) Nine papers are presented summarizing the work of the assembly in the fields of standards, tropospheric and ionospheric propagation, noise, radio astronomy, circuitry and general electronics. For a short report see *Nature, Lond.*, 3rd Sept. 1955, Vol. 176, No. 4479, pp. 451–452.

061.3 : 621.3 **956**

Electronics and Television Convention: Proceedings. [Book Notice]—Supplement to *Ricerca sci.*, Milan, 1954, 2 vols, 10000 lire. (*J. Telev. Soc.*, July–Sept. 1955, Vol. 7, No. 11, p. 482.) Includes all the papers given at this international convention, in the original languages, with summaries in French, German and English. The subjects discussed included magnetic, dielectric and semiconductor materials, electron optics, radar, servomechanisms, computers and cybernetics.

061.6 : 621.3 **957**

The 'Galileo Ferraris' National Electrotechnical Institute.—P. Lombardi. (*Ricerca sci.*, July 1955, Vol. 25, No. 7, pp. 1988–2047.) Report of activities for the two years 1951–1953. The subjects covered include properties of ferromagnetic materials, electroacoustics, electronics, radio engineering and television.

539.1 (44) **958**

Nuclear Energy and its Industrial Applications: Part 1—Atomic Piles and Radioisotopes.—(*Onde élect.*, Oct. 1955, Vol. 35, No. 343, pp. 783–945.) This issue comprises a group of papers providing a survey of developments of atomic energy in France, with descriptions of equipment and methods used.

621.3.002.2 **959**

Automatic Circuit Production.—(*Wireless World*, Jan. 1956, Vol. 62, No. 1, p. 23.) Improvements to the E.C.M.E. machine [1913 of 1947 (Sargrove)] will reduce the preparatory period before a production run from three months to a few days.

621.3.002.2 **960**

Punched Cards control Job-Lot Assembly System.—G. W. Gamble, C. J. Godwin & F. S. Feldheim. (*Electronics*, Nov. 1955, Vol. 28, No. 11, pp. 122–128.) An automatic assembly system for producing complete subassemblies of electronic equipment in batches of up to 20 is described. Etched wiring and dip soldering are used.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.12 **961**

The Principal Frequencies of Vibrating Systems with Elliptic Boundaries.—S. D. Daymond. (*Quart. J. Mech. appl. Math.*, Sept. 1955, Vol. 8, Part 3, pp. 361–372.) Analysis involving Mathieu functions is presented.

534.121.1 **962**

On Upper and Lower Bounds of the Eigenvalues of a Free Plate.—Y. Nakata & H. Fujita. (*J. phys. Soc. Japan*, Sept. 1955, Vol. 10, No. 9, pp. 823–824.) A brief mathematical note on the vibration of a thin elastic plate.

534.2-8 **963**

New Methods for rendering Ultrasonic Waves Visible.—F. Hauer & G. Keck. (*Naturwissenschaften*, Nov. 1955, Vol. 42, No. 22, pp. 601–602.) Both travelling and standing waves in liquids can be made visible by using a specially prepared photographic plate; the sensitive material is dissolved at a rate depending on the strength of the ultrasonic field.

534.612.082.72-8 **964**

Capacitance Analyser of Sound Field.—V. A. Zverev, V. M. Bokov & I. E. Lur'e. (*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 218–220.) A circuit arrangement is described in which a capacitance change corresponding to the fractional change of the dielectric constant of water due to a sound field of frequency 85 kc/s is caused to modulate a r.f. signal; the change in the dielectric constant is of the order of 1 part in 10^6 for a pressure change of 10^5 bar.

534.833 : 534.75 **965**

Apparatus for the Protection of the Hearing from the Damaging Effects of Noise.—I. M. Polkovski. (*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 249–256.) Low-pass mechanical sound filters to be worn over the ears are described. Their attenuation is low up to 1 kc/s but increases rapidly to about 35 dB at 3·5 kc/s.

534.845 **966**

Measurement of the Absorption Coefficient of Acoustic Materials by the Reverberation-Chamber Method.—R. Lamoral. (*Ann. Télécommun.*, Oct. 1955, Vol. 10, No. 10, pp. 206–217.) Formulae for reverberation time developed by Sabine, Eyring and Millington are compared; values calculated from the two latter formulae may differ by as much as 25% for fairly 'dead' studios. Details are given of the test method and installation used by the R.T.F. organization; the volume of the reverberation chamber is 246 m^3, and the excitation sound is a frequency-modulated tone. An electro-optical system for interrupting the sound without producing transients is described. Measurements are reported on panels of various materials either in one piece or divided up and variously arranged; material is most effective when located near the microphone. The results are embodied in graphs suitable for design purposes.

534.86 **967**

Conference on Electroacoustics, Kiev, 1st–5th July 1955.—(*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 294–296.) Brief notes on 17 papers presented at the conference.

534.86 : 534.76 **968**

Secondary Field in Stereophonic Two-Channel Transmission for Various Positions of the Sound Source in the Primary Field.—P. G. Tager. (*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 286–293.) The effect of varying one or more parameters in a system comprising two separate electroacoustic transmission channels on the stereophonic effect at various positions in an auditorium is considered theoretically, reverberation effects being neglected. The principal parameters are the differences of energy levels and time. These are taken into account in calculations by (*a*) the stereophonic-transmission factor $\beta\mu$ and (*b*) the delay factor τ, where β is a function of the directivity of the sound source, microphones and loudspeakers, the amplification factors of the two channels and the constructional factors of the microphones and loudspeakers, and μ is the ratio of the distances between the source and the microphones. Curves and tables are given to facilitate calculations.

534.861.1 **969**

Broadcast Studio Redesign.—L. L. Beranek. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1955, Vol. 64, No.

10, pp. 550–559.) "A review is made of psychoacoustic and audience-opinion information of recent and older sources from which criteria for studio design are drawn. New criteria are proposed for reverberation time for studios and auditoriums used for speech, music and general purposes. Examples of three types of existing studios that need revision are discussed."

621.395.61 **970**

A New Cardioid Microphone.—N. Friedman & C. Macpherson. (*Tele-Tech & Electronic Ind.*, Oct. 1955, Vol. 14, No. 10, pp. 70–72, 133.) A cardioid polar diagram and flat frequency characteristic are achieved by an arrangement of entrance ports and acoustically coupled cavities which also substantially eliminates proximity effect and susceptibility to mechanical shock.

621.395.612.4 **971**

Design of a [pressure-type] **Ribbon Microphone.**—A. V. Rimski-Korsakov. (*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 257–263.) Design formulae are given.

AERIALS AND TRANSMISSION LINES

621.315.213 **972**

Polythene-Insulated Video-Pair Cables.—(*Elect. Commun.*, Sept. 1955, Vol. 32, No. 3, pp. 165–168.) Constructional features and electrical characteristics are described for cables with four, six and eight video pairs.

621.315.687 **973**

Electrical Resistance of Joints in Copper Cables.—K. Sagel. (*Nachrichtentech. Z.*, Oct. 1955, Vol. 8, No. 10, pp. 541–544.) Experimental results show that soldered joints (solder composition 40% Sn, 2·7% Sb, remainder Pb) have a lower resistance, and lower scatter of resistance values, than spliced or welded joints. Results are tabulated and microphotographs are reproduced.

621.372 **974**

A Method of launching Surface Waves.—J. D. Lawson. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, p. 111.) The principle used is to maintain the phase velocity of the wave constant throughout the launching system; tapered-horn arrangements are illustrated.

621.372.21 : 621.315.213 **975**

Strip Transmission Lines.—C. Bowness. (*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, pp. 2–7.) Practical production techniques for strip transmission lines are investigated and the construction of typical component parts of a r.f. system is described. The system has advantages, especially as regards cost, in cases where some stray radiation can be tolerated.

621.372.22 **976**

A Transmission-Line Taper of Improved Design.—R. W. Klopfenstein. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 31–35.) Discussion of the design of a line with Dolph-Tchebycheff taper, which is optimum in the sense that for a given taper length the reflection coefficient is minimum throughout the pass band, while for a specified upper limit to the reflection coefficient the length of the taper is a minimum. Values of transcendental functions used in the design are tabulated.

621.372.22 : 621.314.2 **977**

A Tapered Strip Line for Pulse Transformer Service.—Primozich, Schatz & Woodford. (See 993.)

621.372.8 **978**

Circular and Rectangular Waveguides with Longitudinal Diaphragms.—E. G. Solov'ev. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 707–710.) The propagation of e.m. waves in waveguides with infinitely thin conducting diaphragms, equally spaced along the guide, is considered. The problem is solved by the method of matching the fields at the boundary between two regions. The electric field between the diaphragms is evaluated approximately. One of the dispersion equations obtained for the propagation constant is analysed for the case when the length of the wave in the waveguide is much greater than the space-period of the diaphragm structure.

621.372.8 : 537.226 **979**

Media rendered Artificially Anisotropic.—Ya. B. Fainberg & N. A. Khizhnyak. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 711–719.) An anisotropic medium can be obtained by arranging dielectric disks periodically along the axis of a waveguide, as suggested by Harvie (1744 of 1949). A mathematical discussion shows that the system is equivalent to a waveguide completely filled with an anisotropic dielectric, not only in respect of retarding properties but also in respect of the mean values of the electric and magnetic fields.

621.396.67 **980**

Distribution of Current along a Cylindrical Transmitting Aerial.—P. Poincelot. (*Ann. Télécommun.*, Sept. & Oct. 1955, Vol. 10, Nos. 9 & 10, pp. 186–194 & 219–228.) Detailed analysis. See 932 of 1955 and back references.

621.396.67 **981**

Method for Calculation of the [input] **Conductance of Cylindrical Aerials.**—G. Barzilai. (*Alta Frequenza*, Aug./Oct. 1955, Vol. 24, Nos. 4/5, pp. 339–355.) The method consists essentially in evaluating separately the input voltage and the radiated power for a given value of current in the vicinity of the maximum point. First and second-order calculations are made. For an abbreviated account in English see *Trans. Inst. Radio Engrs*, Jan. 1955, Vol. AP-3, No. 1, pp. 29–32.

621.396.67.012.12 **982**

Radiation Diagrams of Ring Arrays with Rotationally Symmetrical Horizontal Characteristics.—H. W. Fastert. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 9/10, pp. 157–165.) Long-wave aerial systems with sky-wave suppression are discussed. An examination is made of the number of radiators required in practice to give a constant-current system. Analysis for multi-ring systems is simplified by stipulating additional conditions, e.g. maximum gain.

621.396.677 **983**

Synthesis of Aerial Arrays.—A. Fernandez Huerta. (*Rev. Telecomunicación, Madrid*, Sept. 1955, Vol. 9, No. 41, pp. 3–13.) A theoretical study of linear uniformly spaced arrays. By resolving the characteristic polynomial into binomial expressions the radiation diagrams are found rapidly; broadside and end-on arrays are thus treated. Use of Tchebycheff polynomials to obtain optimum distribution and of small spacings to obtain superdirectivity are discussed.

621.396.677.3.012.12 **984**

Design of Line-Source Antennas for Narrow Beam Width and Low Side Lobes.—T. T. Taylor. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. AP-3, No. 1, pp. 16–28.) The effect of nonuniform field distributions across the aerial aperture on the radiation pattern is discussed mathematically. The ideal compromise between beam width and side-lobe level is given by a space factor $\cos \pi \sqrt{u^2 - A^2}$, where $u = (2a/\lambda) \cos \theta$, θ being the angle of radiation and a the half-length of the line source, and $\cosh \pi A$ is the side-lobe ratio. Practical approximations to this ideal pattern are discussed.

621.396.677.833 **985**

Double-Parabolic-Cylinder Pencil-Beam Antenna.—R. C. Spencer, F. S. Holt, H. M. Johanson & J. Sampson. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. AP-3, No. 1, pp. 4–8.) Radiation from a point source on the focal line of one cylinder is reflected in turn from this cylinder and from a second one arranged so that its focal line coincides with the directrix of the first, resulting in the production of a parallel beam. Production advantages of such systems are stressed.

AUTOMATIC COMPUTERS

681.142 **986**

Electronic Computing Machines and their Uses.—J. H. Wilkinson. (*J. sci. Instrum.*, Nov. 1955, Vol. 32, No. 11, pp. 409–415.) Basic design of digital computers is described. Programming for suitable types of problem is discussed and illustrated by examples.

681.142 **987**

A Simple Electronic Fourier Synthesizer.—H. B. Mohanti & A. D. Booth. (*J. sci. Instrum.*, Nov. 1955, Vol. 32, No. 11, pp. 442–444.) An experimental model of a machine for two-dimensional Fourier synthesis is described which incorporates magnetic drum storage of the required sine and cosine functions.

681.142 **988**

Simplified Analog Computer.—V. B. Corey. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 128–131.) A differential analyser is described, based on ten identical operational amplifiers which may be used for integration, multiplication, etc., as required by the particular problem. The arrangement is very flexible and may be used with external circuitry for the generation of special functions required in synthesizing particular input analogues.

681.142 : 621.375.2.024 **989**

Some Aspects of the Design of a D.C. Amplifier for Use with a Slow Analogue Computer.—H. Fuchs. (*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, pp. 22–25.) "The errors introduced as a result of an h.t. resistance common to several amplifiers is calculated, and a criterion for the accuracy of a linear computer stated."

681.142 : 621.375.43 **990**

Transistor Amplifiers for Use in a Digital Computer.—Simkins & Vogelsong. (See 1014.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.21 **991**

Contribution on the Calculation of the Total Impedance of Parallel-Connected Impedances.—W. Boesch. (*Rev. gén. Élect.*, Oct. 1955, Vol. 64, No. 10, pp. 517–520.) A method of calculation involving use of a special transparent rule and a simple nomogram is described and illustrated by a numerical example.

621.3.016.35 : 621-526 **992**

Stability Criteria for an Electrical or Mechanical System with Distributed Parameters.—A. S. Gladwin. (*Brit. J. appl. Phys.*, Nov. 1955, Vol. 6, No. 11, pp. 400–402.) For electrical or mechanical systems with distributed parameters, or with an element producing a finite time delay, to be stable all the roots of the appropriate characteristic equation must be negative or have negative real parts. If the equation is expressed in the form $C_0 + C_1 z + (C_2 + C_3 z) \tanh z = 0$, then for C_0 positive, C_1 and C_2 must be positive and C_2/C_1 must be greater than a certain critical value which is a function of C_0/C_2. An example is given of the application of these criteria to a servomechanism.

621.314.2 : 621.372.22 **993**

A Tapered Strip Line for Pulse Transformer Service.—F. G. Primozich, E. R. Schatz & J. B. Woodford. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, p. 908.) Digest of paper in *Trans. Amer. Inst. Elect. Engrs*, Part I, *Communication and Electronics*, May 1955, Vol. 74, pp. 158–161. A rolled-up construction is described for an exponential-line impedance transformer. The impedance is 25 Ω at one end of the 10-m line and 1 000 Ω at the other; pulses as long as 36 mμs can be handled.

621.316.825 + [621.314.632 : 546.289 **994**

The Turnover Phenomenon in Thermistors and in Point-Contact Germanium Rectifiers.—R. E. Burgess. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 908–917.) The turnover power in thermistors increases as the square of the absolute ambient temperature. The similarity in form between the reverse characteristic of a point-contact Ge rectifier and the static characteristic of a thermistor suggests a thermal hypothesis for rectifier turnover; but in the latter case the turnover power decreases approximately linearly with ambient temperature. The type of function necessary to reproduce the rectifier characteristics at turnover is discussed; such a function cannot be derived from existing theories of rectification.

621.318.424 : 621.318.134 **995**

A Survey of the Application of Ferrites to Inductor Design.—R. S. Duncan & H. A. Stone, Jr. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 4–13.)

621.318.435 : 621.375.3 **996**

Influence of I.D.-O.D. [inside-diameter/outside-diameter] **Ratio on Magnetic Properties of Toroidal Cores.**—R. W. Roberts & R. I. Van Nice. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, pp. 910–914.) The optimum design of cores for magnetic amplifiers is discussed. A theoretical result is obtained assuming a parallelogram-shaped hysteresis loop, and an experimental investigation is reported. The dependence of the optimum ratio on the magnetic properties of the core material is indicated.

621.318.57 + 621.314.7 + 621.385 **997**

Design of Electronic Devices for Production.—Thomson. (See 1249.)

621.319.4 : 621.387 **998**

Electrically Variable Gas-Dielectric Capacitor.—J. F. Gordon. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 158–160.) A neon tube placed between the plates of an air-dielectric capacitor gives a variation in dielectric constant proportional to the tube current. Maximum variation of capacitance is about 10%. The device may be used for frequency control of self-excited oscillators.

621.372 **999**

A Simplified Method of solving Linear and Nonlinear Systems.—R. Boxer & S. Thaler. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 89–101.) The method described uses the z transform [363 of 1955 (Ragazzini & Bergen)] directly to determine the responses of linear and nonlinear systems approximately. The solutions are given as time series representing the values of the response at equally spaced instants. Both constant and time-varying systems are considered.

621.372.413 **1000**

The Harmodotron—a Beam Harmonic Higher-Order-Mode Device for producing Millimeter and Submillimeter Waves.—P. O. Coleman & M. D. Sirkis. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1385–1386.) High-power oscillations are generated by

exciting a single higher-order TM mode in a cylindrical cavity by means of a bunched beam of 1–1·5-MeV electrons.

621.372.542.2.01 **1001**

Simultaneous Approximation for the Amplitude and Delay Time of an Ideal Low-Pass Filter using the Flow Analogy.—J. Peters. (*Arch. elekt. Übertragung*, Oct. 1955, Vol. 9, No. 10, pp. 453–459.) Analogies between transmission phenomena in networks and current flow in a potential field are discussed [2370 of 1951 (Darlington)]. A distortion-free low-pass filter can be represented by two superposed fields, one with parallel flow, corresponding to the distortion-free aspect, and the other with radial flow, corresponding to the filter aspect. Such a representation involves a finite residual error which cannot be eliminated without introducing instability, but which can be reduced indefinitely by increasing the delay time.

621.372.543.2 : 538.652 **1002**

Electromechanical Filters for 100-kc/s Carrier and Sideband Selection.—R. W. George. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 14–18.) Torsional-type filters comprising $\lambda/2$ cylindrical resonators with $\lambda/4$ coupling necks are discussed. Descriptions are given of two filters with bandwidths of 50 c/s and 3·1 kc/s respectively. Using a particular Fe-Ni-Cr-Ti alloy known as Ni-Span-C, the temperature variation of frequency is < 2 parts per million. Magnetostrictive transducers made of this alloy or of ferrite are used. Spurious modes of vibration are reduced by a balanced arrangement of the transducers and by mechanical damping in the end supports.

621.372.56 **1003**

A Push-Button Attenuator for Frequencies up to 10 Mc/s.—H. Paardekooper. (*Commun. News*, Oct. 1955, Vol. 16, No. 1, pp. 10–22.) Details are given of a resistance attenuator providing attenuation up to 99·5 dB in 1-dB steps with an interpolation step of 0·5 dB. Each section comprises a T-network with the shunt arm bridged by capacitance to compensate the inductance of the series arms.

621.373.4.029.65 **1004**

Cherenkov Radiation.—J. G. Linhart. (*Research, Lond.*, Oct. 1955, Vol. 8, No. 10, pp. 402–406.) A brief explanation is given of the mechanism of Cerenkov radiation, which may find application in mm-λ oscillators.

621.373.421 **1005**

Cathode-Follower Phase-Shift Oscillator.—J. C. Samuels. (*Elect. Commun.*, Sept. 1955, Vol. 32, No. 3, pp. 198–202.) Analysis indicates that better frequency stability is obtained by connecting the phase-shifting network between grid and cathode than by connecting it in the anode circuit. Calculations are made for three typical circuits.

621.373.431.1 **1006**

Investigations of the D.C. and A.C. Characteristics of Bi-stable Multivibrators.—K. Gosslau H. J. Harloff. (*Nachrichtentech. Z.*, Oct. 1955, Vol. 8, No. 10, pp. 521–530.) The characteristics are discussed theoretically with reference to the design of reliable counting and switching units. Design procedure is illustrated by two numerical examples, one of a binary counting unit with counting rate up to 1 Mc/s at supply voltages between 50 and 350 V, the other for a pulse-counting rate of 10 Mc/s at supply voltages between 60 and 300 V. A modification of the latter circuit using a Type-E88CC double-triode, instead of Type-E90CC, was used at counting rates up to 30 Mc/s.

621.374.3 : 621.318.57 **1007**

The Diode Pump Integrator.—J. B. Earnshaw. (*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, pp. 26–30.) The design of a diode circuit for integrating a train of pulses is discussed and conditions are established for linear and nonlinear operation. An application to a frequency-sensitive relay with quick 'on-off' characteristics is described.

621.374.32 **1008**

A Logarithmic Voltage Quantizer.—E. M. Glaser & H. Blassbalg. (*Tele-Tech & Electronic Ind.*, Oct. 1955, Vol. 14, No. 10, pp. 73–75..128.) Details are given of an analogue-to-digital converter which provides an output pulse whose duration is proportional to the logarithm of the input voltage, the output pulse duration being determined by counting the number of fixed-frequency pulses occurring in the same interval. Range of input voltage is 3·3–100 V, with a threshold input pulse length of 0·5 μs.

621.374.32 **1009**

Analog-to-Digital Data Converter.—S. Rigby. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 152–155.) The required conversion is performed by arranging an oscillator generating pulses at a repetition rate proportional to the analogue voltage to feed a digital counter for a fixed period. The oscillator described has a range of four decades; stability is better than 0·1% of maximum pulse frequency.

621.375.221 **1010**

The Compensation of Wide-Band Amplifiers at High Frequencies.—P. Rohan & J. Weislitzer. (*Proc. Instn Radio Engrs, Aust.*, Oct. 1955, Vol. 16, No. 10, pp. 354–362.) Analysis is given for various coupling arrangements including *RC*, *RCL* and special two- and four-terminal networks.

621.375.23 : 621.3.018.78 **1011**

Distortion in Feedback Amplifiers.—R. W. Ketchledge. (*Bell Syst. tech. J.*, Nov. 1955, Vol. 34, No. 6, pp. 1265–1285.) Analysis is presented for frequency-dependent feedback. Consideration is restricted to cases where the distortion products are comparatively small and the nonlinear element can be described by a power series with only a few terms. Formulae are derived for a number of third-order products.

621.375.4 : 621.314.7 **1012**

Analysis of the Common-Base Transistor Circuit.—R. L. Pritchard. (*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, p. 40.) Mathematical errors in a paper by Oakes (1600 of 1955) are pointed out.

621.375.4 : 621.314.7 **1013**

Transistor Circuit for Resonance-Coefficient Multiplier.—M. Soldi & M. Valeriani. (*Alta Frequenza*, Aug./Oct. 1955, Vol. 24, Nos. 4/5, pp. 375–389.) Use of transistors in Q-multiplier circuits [2678 of 1951 (Harris)] is discussed. The input admittance is calculated and the conditions for stabilization against self-oscillation are derived. Design and performance of experimental arrangements are described; composite transistors [927 of March (Pearlman)] may be used.

621.375.43 : 681.142 **1014**

Transistor Amplifiers for Use in a Digital Computer.—Q. W. Simkins & J. H. Vogelsong. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 43–55.) Pulse-regenerative amplifiers for a 3-Mc/s synchronous binary computer are based on use of external feedback, so that a negative-resistance transistor characteristic is not required. By using semi-gated feedback, allowance can be made for the slow recovery of Ge diodes incorporated in the circuit.

621.372 + 621.317].029.63/.64 **1015**

Schaltungstheorie und Messtechnik des Dezimeter-und Zentimeterwellengebietes. [Book Review]—A. Weissfloch. Publishers: Birkhäuser, Basel, 1954, 308 pp., Swiss Fr. 29.30. (*Bull. schweiz. elektrotech. Ver.*, 29th Oct. 1955, Vol. 46, No. 22, p. 1092.) Theory and applications of four-, six-, and eight-pole networks are covered. Circle-diagram representation is used to show transformation properties of four-pole networks.

GENERAL PHYSICS

535.325 : 538.566.2.029.6 **1016**

The Refractive Indices of Water Vapour, Air, Oxygen, Nitrogen and Argon at 72 kMc/s.—K. D. Froome. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 833–835.) Experiments indicate that the refractive indices of water vapour, air and oxygen are modified at microwave frequencies in the manner to be expected from dipole theory; the values for nitrogen and argon should not vary with frequency, and this is confirmed.

537.122 **1017**

The Dielectric Theory of Electronic Interactions in Solids.—J. Hubbard. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431A, pp. 976–986.) The long-range part of the Coulomb interaction of the electrons in solids is treated by regarding the solid as a homogeneous dielectric. Sustained oscillations are shown to be possible in metals and are identified with the plasma oscillations discussed by Bohm & Pines (1375 of 1954).

537.21 **1018**

The Capacity and Field of a Cylindrical Trough with a Plane Conductor in the Axial Plane of Symmetry.—H. J. Peake & N. Davy. (*Brit. J. appl. Phys.*, Nov. 1955, Vol. 6, No. 11, pp. 404–408.)

537.21 : 517.9 **1019**

Poisson's Partial Difference Equation.—H. Davies. (*Quart. J. Math.*, Sept. 1955, Vol. 6, No. 23, pp. 232–240.) The Green's functions and their asymptotic behaviour for Poisson's partial difference equation in two and three dimensions are discussed and the distribution of potential and current in a regular grid of wires is calculated. The method may also be applied to non-isotropic grids and can be extended to triangular and hexagonal grids in two dimensions and probably to more complicated patterns in three dimensions.

537.311.31 **1020**

Theory of Electrical Conductivity in Metals.—P. S. Zyryanov. (*Zh. eksp. teor. Fiz.*, Aug. 1955, Vol. 29, No. 2(8), pp. 193–200.) The fluctuations in the potential in the electron-ion plasma of a metal and the electrical resistance due to the scattering of electrons by these fluctuations are calculated.

537.311.31 **1021**

Number of States and the Magnetic Properties of an Electron Gas.—A. W. Sáenz & R. C. O'Rourke. (*Rev. mod. Phys.*, Oct. 1955, Vol. 27, No. 4, Part I, pp. 381–398.) A theoretical investigation of the thermodynamic properties of conduction electrons in metals.

537.311.33 : 538.614 **1022**

The Infrared Faraday Effect due to Free Carriers in a Semiconductor.—E. W. J. Mitchell. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 973–974.)

537.52 : 546.11 **1023**

Growth of Pre-breakdown Ionization Currents in Hydrogen.—R. W. Crompton, J. Dutton & S. C. Haydon. (*Nature, Lond.*, 3rd Dec. 1955, Vol. 176, No. 4492, p. 1079.) Experiments are briefly reported, the results of which indicate that the mechanism of primary ionization is the same over a range of pressures from a few mm to 150 mm Hg.

537.52 : 621.317.729.2 **1024**

Theory of Langmuir Probes.—Yu. M. Kagan & V. I. Perel'. (*Zh. eksp. teor. Fiz.*, Aug. 1955, Vol. 29, No. 2(8), pp. 261–263.) A note contrasting results of Langmuir's theory with those of the authors' precise theory of the spherical probe at low pressures and negative probe potential (*C. R. Acad. Sci. U.R.S.S.*, 1954, Vol. 95, No. 4, pp. 765–768. In Russian).

537.525 : 621.385.833 **1025**

Electric 'Microdischarges' in a Dynamic Vacuum.—R. Arnal. (*Ann. Phys., Paris*, Sept./Oct. 1955, Vol. 10, pp. 830–873.) Account of an experimental and theoretical investigation of undesired discharges occurring as a result of surface imperfections in vacuum apparatus operated at high voltage. Experimental electrode systems similar to those in electron microscopes were used. The phenomena are distinguishable from field emission, and involve repeated secondary emission of electrons and H ions. For voltages applied in very short pulses the upper limit before onset of microdischarges is higher than for continuous voltages.

537.533 **1026**

Some Factors influencing Field Emission and the Fowler-Nordheim Law.—T. J. Lewis. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 938–943.) "Departures from the normal Fowler-Nordheim law which have been observed at fields up to 7×10^7 V cm^{-1} have previously been ascribed to space-charge field distortion. It is shown that certain other effects due to failure of the image law, non-uniformity of work function and to possible surface irregularities could produce similar effects."

537.533 **1027**

Electron Emission from Metal Surfaces after Mechanical Working.—J. Lohff & H. Raether. (*Z. Phys.*, 1st Oct. 1955, Vol. 142, No. 3, pp. 310–320.) A fuller account of work described previously (2265 of 1955). Electron multiplication by secondary emission was used to facilitate the observations.

537.533 : 539.211 **1028**

A Study of the Structure of Abraded Metal Surfaces.—L. Grunberg & K. H. R. Wright. (*Proc. roy. Soc. A*, 8th Nov. 1955, Vol. 232, No. 1190, pp. 403–423.) A report is presented of an experimental investigation of the spontaneous and photoelectric electron emission from abraded surfaces in various atmospheres. All the metals investigated responded to radiation in the near ultraviolet; Al, Mg and Zn, which form 'excess metal' oxides, responded to wavelengths in the visible range also. From the observed rate of decay of emission it is inferred that both thermal and oxidation phenomena are involved. Previous theories that the emission depends on exothermal processes [2301 of 1953 (Kramer)] are considered untenable.

537.56 : 536.2 **1029**

Theory of Thermal Conductivity of a Plasma.—H. Schirmer. (*Z. Phys.*, 12th Sept. 1955, Vol. 142, No. 2, pp. 116–126.) The treatment is similar to that used previously for investigating the electrical conductivity of plasma (382 of February).

537.562 : 538.6 **1030**

Particle Transport, Electric Currents, and Pressure Balance in a Magnetically Immobilized Plasma.—P. Stehle. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, p. 443.) The problem discussed by Tonks (2595 of 1955) is treated without detailed analysis of particle trajectories; qualitatively similar results are obtained.

538.222 **1031**

A Note on the Paramagnetic Relaxation.—M. Yokota. (*J. phys. Soc. Japan*, Sept. 1955, Vol. 10, No. 9, pp. 762–768.) The theory given explains experimental results obtained by Gorter (*Paramagnetic Relaxation*, 1947) for the dependence of the spin-spin relaxation time on the static field strength.

538.3 **1032**

Electromagnetic Theory of Moving Matter: Part 2.—E. J. Post. (*Tijdschr. ned. Radiogenoot.*, Sept. 1955, Vol. 20, No. 5, pp. 307–321. In English.) Part 1: 3230 of 1955.

538.311 **1033**

Magnetic Field due to Circular Current.—R. Cazenave. (*Rev. gén. Élect.*, Oct. 1955, Vol. 64, No. 10, pp. 510–512.) Analysis is simplified by applying recent work on elliptic integrals.

538.561 : 537.533 **1034**

Production of Millimetre Waves by a Magnetic Undulator.—R. Combe & T. Frelot. (*C. R. Acad. Sci., Paris*, 28th Nov. 1955, Vol. 241, No. 22, pp. 1559–1560.) Measurements have been made on a device of a type described previously [1037 of 1954 (Combe & Feix) and back references] using an electron beam from a pulsed linear accelerator. With a mean beam intensity of 0·3 μA, the output power was about 1 mW, intermediate between the values corresponding to complete incoherence and complete coherence of the elementary vibrations. The spectrum extended from 4·8 to 8 mm with a maximum at 5·75 mm.

538.566 : 537.226.2 **1035**

Transmission of Electromagnetic Waves through Inhomogeneous Layers.—H. G. Haddenhorst. (*Z. angew. Phys.*, Oct. 1955, Vol. 7, No. 10, pp. 487–496.) Layers are considered in which the dielectric constant is graded from the value unity at each face to a maximum value at the mid-plane, the variation being either linear or exponential. Dielectrics are prepared satisfying this specification by forming ordinary homogeneous materials into a series of wedges or the like, thus producing a space-periodic structure. Reflection-factor measurements made in free space and in waveguides are reported. Variation of reflection factor with layer thickness is shown graphically for moltopren, paraffin and trolitul; variation with angle of incidence is shown for trolitul. The experimental results are compared with values of the reflection factor calculated from solutions of Maxwell's equations for the appropriate conditions. Such structures can give good transmission of microwaves over a wide frequency band.

538.566.029.6 **1036**

Generation of Submillimeter Waves.—H. Motz & K. B. Mallory. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, p. 1384.) Brief preliminary note describing radiation observed unexpectedly when a bunched high-energy beam of electrons was passed through a simple rectangular waveguide.

538.569.4 : 535.33 **1037**

Pulse Techniques in Microwave Spectroscopy.—R. H. Dicke & R. H. Romer. (*Rev. sci. Instrum.*, Oct. 1955, Vol. 26, No. 10, pp. 915–928.) "Methods are described for exciting gases to states from which they emit coherent spontaneous radiation in the microwave frequency region. The excitation is produced by the application of short pulses of microwave power. The power subsequently radiated by the gas is calculated for several cases, and experimental methods used to detect the radiation are described. The problem of sensitivity is discussed and compared to the sensitivity obtainable in a continuous absorption experiment. The operation of a high resolution microwave spectrometer, which produces lines substantially narrower than the usual Doppler width, is described. The method used to stabilize the klystron used in these experiments, which is a modification of the Pound i.f. method, is given." See also 92 of January (Romer & Dicke).

538.569.4 : 539.152.2 **1038**

Spin Echo Serial Storage Memory.—A. G. Anderson, R. L. Garwin, E. L. Hahn, J. W. Horton, G. L. Tucker & R. M. Walker. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1324–1338.) Methods are discussed for storing information in the form of pulses in a nuclear-magnetic-resonance system, by use of the free-induction spin-echo technique [see also 1962 of 1955 (Fernbach & Proctor)]. The storage capacity in liquids is expressed in terms of the thermal noise of the detecting apparatus, the self-diffusion of the molecules, and the relaxation times. Undesired echoes arising from the interaction of input pulses are eliminated by f.m. and magnetic-field-modulation techniques. Glycerin and solutions of paramagnetic ions in water provide storage times of 10–50 ms, with a storage capacity of the order of 1 000 echoes. Larger capacities expected from liquids with long relaxation times are not realized owing to self-diffusion.

538.632 **1039**

The Hall Effect in Metals at High Frequencies.—B. Donovan. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431A, pp. 1026–1032.) Theory is developed in terms of a 'surface Hall coefficient'; calculations are made for a metal with two overlapping energy bands, and the variations with frequency and with field strength are shown graphically for some special cases. At very low frequencies the Hall coefficient is constant; over a range of higher frequencies it increases as the square root of the frequency and then becomes constant again. The frequency variation of the phase angle between current and Hall e.m.f. is also investigated.

538.652 **1040**

Quantum Theory of Magnetostriction.—A. A. Gusev. (*Zh. eksp. teor. Fiz.*, Aug. 1955, Vol. 29, No. 2(8), pp. 181–192.) The theory of magnetostriction in hexagonal single crystals is developed on the basis of a polar model [*ibid.*, 1950, Vol. 19, pp. 256, 261 (Bogolyubov & Tyablikov)] by considering the magnetic and magnetoelastic interaction of electrons in the lattice. The energy spectrum of the crystal at low temperatures, the free energy and the temperature dependence of magnetostriction constants are calculated.

538.652 : 537.312.62 **1041**

Some Consequences of the Influence of Elastic Deformations on Superconductivity: Magnetostriction.—C. Grenier. (*C. R. Acad. Sci., Paris*, 7th Nov. 1955, Vol. 241, No. 19, pp. 1275–1277.) Analysis of conditions at the transition from the normal-conduction to the superconduction state in tin indicates that magnetostriction mainly in the direction of the quaternary axis is to be expected. Conditions for Hg are more complex.

548.0 : 53 **1042**

Effect of Defects on Lattice Vibrations.—E. W. Montroll & R. B. Potts. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 525–543.) "The theory of the effect of localized defects such as impurities, holes, and interstitials on the vibrations of crystal lattices is developed."

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **1043**

International Research in Radio Astronomy.—R. L. Smith-Rose. (*Nature, Lond.*, 10th Dec. 1955, Vol. 176, No. 4493, pp. 1110–1111.) Special Reports Nos. 3, 4 and 5 published by the International Scientific Radio Union, and entitled respectively 'Discrete Sources of Extraterrestrial Radio Noise', 'The Distribution of Brightness on the Solar Disk', and 'Interstellar Hydrogen' are noticed.

523.16 **1044**

Results of Observations of Discrete Emitters of Cosmic Radio Emission on Wavelength $\lambda = 3{\cdot}2$ cm.—N. L. Kaidanovski, N. S. Kardashev & I. S. Shklovski. (*C. R. Acad. Sci. U.R.S.S.*, 1st Oct. 1955, Vol. 104, No. 4, pp. 517–519. In Russian.) Results are given of a determination of the e.m. flux at 3·2-cm λ originating from the Omega nebula (NGC 6618), Orion nebula (NGC 1976), Cassiopeia A (supernova A.D. 369), Taurus A (NGC 1952, supernova A.D. 1054) and a source near the galactic centre Sagittarius X (possibly supernova A.D. 827). When these values are plotted together with observations at other radio wavelengths and, in the case of the Crab nebula, also at optical wavelengths, the results suggest that one mechanism may be responsible for radiation both at optical and radio wavelengths.

523.165 : 550.385 **1045**

The 27-Day Recurrence Tendency of Cosmic-Ray Intensity.—I. J. van Heerden & T. Thambyahpillai. (*Phil. Mag.*, Nov. 1955, Vol. 46, No. 382, pp. 1238–1251.) The 27-day-cycle variations of cosmic-ray intensity precede those of magnetic activity by about five days; it is tentatively suggested that the same solar disturbances are associated with both phenomena.

523.5 : 621.396.11 **1046**

Diurnal Variations in the Number of Shower Meteors detected by the Forward-Scattering of Radio Waves: Part 2—Experiment.—P. A. Forsyth, C. O. Hines & E. L. Vogan. (*Canad. J. Phys.*, Oct. 1955, Vol. 33, No. 10, pp. 600–606.) "The theory developed in Part 1 [738 of March (Hines)] is applied to derive the expected diurnal variations of the meteor signal rate for four showers as observed by means of a particular forward-scatter transmission path (Cedar Rapids—Ottawa). These results are then compared with the experimental signal rates. The good agreement obtained indicates that the approximations inherent in the theory are sufficiently accurate for practical purposes. The results also indicate that very few meteors, if any, are observed under conditions which do not satisfy the requirements for specular reflection."

523.746.5 **1047**

The Decreasing Phase of the Last Solar Cycle, as indicated by Measurements at the Astronomical Observatory at Rome.—T. Fortini. (*R. C. Accad. naz. Lincei*, Sept./Oct. & Nov. 1955, Vol. 19, Nos. 3/4 & 5, pp. 131–136 & 272–276.) Detailed observations are compared with those obtained at Zürich.

551.510.535 **1048**

Thermal Upward Flow in the Ionosphere.—Syun-ichi Akasofu. (*Sci. Rep. Tohoku Univ., 5th Ser., Geophys.*, June 1955, Vol. 6, No. 3, pp. 150–161.) The possibility of atmospheric waves due to heating effects of solar radiation is established; vertical thermal flow in the F_2 region may give rise to ion drift along the magnetic lines of force; this may explain anomalous diurnal variations in the F_2 layer. By applying the theory to observed ionospheric data for the North American zone estimates are obtained for the velocity of the ions and of the thermal flow.

551.510.535 **1049**

The Detection of the *Sq* Current System in Ionospheric Radio Sounding.—E. V. Appleton, A. J Lyon & A. G. Pritchard. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 292–295.) Anomalies found in the application of Chapman's theory of ionosphere layer formation to E-layer phenomena are explicable if it is accepted that the *Sq* current system modifies the diurnal variation of electron density in the layer, most probably by some form of vertical-drift mechanism. Similar phenomena are found in the F_1 layer.

551.510.535 : 621.396.11 **1050**

The Night-Time Lower Ionosphere as deduced from a Theoretical and Experimental Investigation of Coupling Phenomena at 150 kc/s.—R. W. Parkinson. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 203–234.) Experimental work over the period March 1953 to January 1954 is described and the results are compared with theoretical results given by Davids & Parkinson (1192 below). Curves show seasonal and diurnal variations of the night-time D layer in the coupling region. D–E-region models for the sunset period for July and November 1953 are proposed; the variation of electron distribution during the night is deduced from a recombination-coefficient model suggested by Mitra (*Scientific Report No.* 68, Ionospheric Research Laboratory, State College, Pennsylvania). All available experimental data tend to confirm the theoretical analysis.

551.510.535 : 621.396.11 **1051**

On the Variation of Ionospheric Absorption at Different Stations.—W. R. Piggott. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 244–246.) "The possibility that the day-to-day changes in absorption at Slough, Swansea and Freiburg are identical is examined statistically. After allowing for known sources of error, it is considered that the residual differences in summer months are too small to be significant, but that it is probable that real differences occur in winter. In both cases the minimum probable correlation for the Swansea–Slough comparison is very high—about 0·92."

551.510.535 : 621.396.11 **1052**

Selective Annotated Bibliography on Ionospheric Propagation.—M. Rigby & M. L. Rice. (*Met. Abstracts Bibliography*, April 1955, Vol. 6, No. 4, pp. 489–547.) Includes some 300 references covering the period 1902–1955.

551.594.5 : 551.51 **1053**

Measurements of the Mean Lifetime of the Metastable ^1S-state of the Oxygen Atom in the Upper Atmosphere during Auroral Displays.—A. Omholt & L. Harang. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 247–253.) The mean lifetime of the OI ^1S level is found to vary between 0·45 and 0·75 sec.

LOCATION AND AIDS TO NAVIGATION

621.396.93 + 621.396.96 **1054**

Contributions of the Siemens Company to Air-Safety Technique and Air-Navigation Electronics in the Years 1930–1945.—H. J. Zetzmann. (*Frequenz*, Oct. & Nov. 1955, Vol. 9, Nos. 10 & 11, pp. 351–360 & 386–395.) A detailed illustrated account covering radar equipment, altimeters, navigation aids and transmission technique.

621.396.96 **1055**

Shore-Based Radio Aids to Navigation on Centimetric Wavelength.—J. M. F. A. van Dijk, N. Schimmel & E. Goldbohm. (*Tijdschr. ned. Radiogenoot.*, Sept. 1955, Vol. 20, No. 5, pp. 271–279. In English.) "The problem of shore-based radar as a navigational aid for shipping is discussed from the system engineering point of view. A short review of the work carried out in the Netherlands, Belgium and Western Germany is given."

621.396.96 **1056**

A Ramark Beacon for Use with Marine Radars.—J. M. F. A. van Dijk, N. Schimmel & E. Goldbohm. (*Tijdschr. ned. Radiogenoot.*, Sept. 1955, Vol. 20, No. 5, pp. 281–290. In English.) Description of wide-band 3-cm-λ equipment with a range of 30 miles. A diversity system of transmitting aerials is used. The ramark signal can be eliminated from the ship's p.p.i. by switching on the fast-time-constant anti-clutter circuit provided in the marine radar. Results of trials are discussed.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 + 537.311.33 **1057**

Ultrashort Light and Voltage Pulses applied to Silver Halide Crystals by Turbine-Driven Mirror and Spark-Gap Switch.—J. H. Webb. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1309–1314.) Technique for studying electron mobility at room temperature is described.

535.215 **1058**

Photoelectric Yields in the Vacuum Ultraviolet.—W. C. Walker, N. Wainfan & G. L. Weissler. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1366–1371.) Measurements are reported on polycrystalline specimens of Ni, Cu, Pt, Au, W, Mo, Ag and Pd exposed to radiation of wavelengths 473–1 400 Å.

535.215 : 538.221 **1059**

Photoelectron Emission in a Ferromagnetic Material.—A. Z. Veksler. (*Zh. eksp. teor. Fiz.*, Aug. 1955, Vol. 29, No. 2(8), pp. 201–208.) Formulae are derived for the velocity distribution of photoelectrons and the temperature dependence of the photocurrent near the Curie point. The calculations are made on the basis of Vonsovski's *s-d* exchange model (*ibid.*, 1946, Vol. 16, p. 981). Results show that the photocurrent varies quadratically with magnetization.

535.215 : 546.482.21 **1060**

Infrared Quenching of Cadmium Sulfide.—S. H. Liebson. (*J. electrochem. Soc.*, Sept. 1955, Vol. 102, No. 9, pp. 529–533.) "Infrared quenching of CdS has been investigated as a function of applied voltage and both infrared and exciting light intensities. Infrared quenching of photoconductivity due to light of wavelengths shorter than that corresponding to the absorption edge increases as the voltage is increased. The quenching spectrum is found to shift with temperature in approximately the same amount as the corresponding shift of the absorption edge. An explanation of infrared quenching is offered based on infrared freed holes recombining with trapped electrons within the crystal."

535.215 : 546.482.21 **1061**

Nonstationary Processes in Photoconductors: Part I—Slow Build-Up of Photoconduction in CdS Single Crystals as a Method for Analysis of Disturbed States.—K. W. Böer & H. Vogel. (*Ann. Phys., Lpz.*, 15th Oct. 1955, Vol. 17, No. 1, pp. 10–22.) Observed photoconductivity build-up curves obtained with weak illumination exhibit inflection points from whose positions the concentration of acceptor impurities can be determined.

535.3 **1062**

Optical Properties of Cadmium Sulfide and Zinc Sulfide from 0·6 Micron to 14 Microns.—J. F. Hall, Jr, & W. F. C. Ferguson. (*J. opt. Soc. Amer.*, Sept. 1955, Vol. 45, No. 9, pp. 714–718.)

535.33/.34 : 537.228.1 **1063**

[Optical] **Vibration Spectrum of Piezoelectric Crystals: Part 5—Lithium Sulphate and Potassium Sulphate.**—J. P. Mathieu, L. Couture & H. Poulet. (*J. Phys. Radium*, Oct. 1955, Vol. 16, No. 10, pp. 781–785.) A study was made of the Raman and infrared-absorption spectra of single crystals with various orientations.

535.37 **1064**

Oxidation States of Europium in the Alkaline Earth Oxide and Sulfide Phosphors.—P. M. Jaffe & E. Banks. (*J. electrochem. Soc.*, Sept. 1955, Vol. 102, No. 9, pp. 518–523.)

535.37 **1065**

Preliminary Studies of the Perovskite-Type Ternary Oxides as Luminophors.—S. Terol & R. Ward. (*J. electrochem. Soc.*, Sept. 1955, Vol. 102, No. 9, pp. 524–528.) Report of an investigation of phosphors with $LaAlO_3$ base and various activators.

535.37 **1066**

Yellow Luminescence caused by Titanium in Magnesium Silicate containing Fluoride.—H. Dziergwa & H. Panke. (*Z. Phys.*, 1st Oct. 1955, Vol. 142, No. 3, pp. 259–265.) Quantum yield, temperature dependence, absorption and afterglow are investigated for $MgF_2.MgO.SiO_2$ phosphors containing TiO_2 alone or with MnO.

535.37 : 546.412.84 **1067**

The Influence of the Crystal Structure on the Luminescence of Calcium Silicate (Mn, Pb).—H. Lange & G. Kressin. (*Z. Phys.*, 15th Oct. 1955, Vol. 142, No. 4, pp. 380–386.)

535.376 **1068**

Electroluminescence. Absolute Brightness Waves and Mean Lifetime of Excited Centres.—G. Destriau. (*J. Phys. Radium*, Oct. 1955, Vol. 16, No. 10, pp. 798–800.) The frequency variation of the alternating and steady components of brightness was studied for ZnS with various activators; the dependence of the relative amplitudes of the two components on the mean lifetime of the excited centres was demonstrated.

535.376 **1069**

Thermoluminescence Measurements of Electroluminescent ZnS:Mn Films.—R. E. Freund. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 760–761.) A typical glow curve is shown for a film which emitted light on application of an alternating or direct field; the measurements were made over the temperature range −196° to +25°C.

535.376 : 537.534.9 **1070**

Deterioration of Luminescent Phosphors under Positive-Ion Bombardment.—J. R. Young. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1302–1306.) "The reduction of cathodoluminescence efficiency of phosphors has been observed after bombarding with H^+, H_2^+, He^+, Ne^+, N_2^+ and A^+ ions having energies from 1 to 25 keV. Detectable deterioration could be observed after a bombardment of less that 10^{-8} coul/mm² of ions (5×10^{11} ions/cm²). The deterioration could be

annealed out at temperatures between 450° and 700°C. Results indicate that light 25-keV ions probably penetrate 0·1 μ to 0·2 μ into the phosphor." The phosphors studied were mainly ZnS:Ag.

535.376 : 546.472.21 **1071**

Edge Electroluminescence from ZnS Single Crystals.—R. W. Smith. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, p. 760.) Experimental results are presented which indicate that both free electrons and holes may contribute to the electroluminescence of ZnS.

537.226/.227 : 546.431.824-31 **1072**

Single-Crystal Neutron Analysis of Tetragonal $BaTiO_3$.—B. C. Frazer, H. R. Danner & R. Pepinsky. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 745–746.)

537.227/.228.1 **1073**

Properties of Piezoelectric Ceramics in the Solid-Solution Series Lead-Titanate/Lead-Zirconate/Lead-Oxide: Tin Oxide and Lead-Titanate/Lead-Hafnate.—B. Jaffe, R. S. Roth & S. Marzullo. (*J. Res. nat. Bur. Stand.*, Nov. 1955, Vol. 55, No. 5, pp. 239–254.) Results of a detailed investigation are reported. Ferroelectric ceramics with composition close to a morphotropic phase boundary exhibit high dielectric constant and relatively good piezoelectric properties. Where polymorphic inversions below the Curie temperature do not occur, these desirable properties are stable over a wide temperature range. The significance of the results for transducer materials is indicated.

537.227 : 546.431.824-31 **1074**

Observations on Etched Crystals of Barium Titanate.—D. S. Campbell. (*Phil. Mag.*, Nov. 1955, Vol. 46, No. 382, pp. 1261–1262.) Observations similar to those reported by Hooton & Merz (2990 of 1955) have been made using hydrochloric acid and phosphoric acid on crystals direct from the melt, with no polarizing treatment. Photomicrographs are reproduced.

537.228.2 : 546.431.824-31 **1075**

Temperature Dependence of Electrostrictive and Elastic Properties of Ceramic Barium Titanate.—N. A. Roi. (*Akust. Zh.*, July–Sept. 1955, Vol. 1, No. 3, pp. 264–271.) An experimental investigation over the temperature range 15°–150°C is reported. Results are presented graphically.

537.311.31 : 537.311.62 **1076**

Surface Resistance and Reactance of Metals at Infrared Frequencies.—J. R. Beattie & G. K. T. Conn. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 78–81.) Properties of Ag, Al, Cu and Ni surfaces have been studied over the frequency range 2·5–15 $\times 10^{13}$ c/s. Experimental results are compared with predictions from theory.

537.311.33 **1077**

Reflectivity of Several Crystals in the Far Infrared Region between 20 and 200 Microns.—H. Yoshinaga. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 753–754.) Results of measurements on Ge, Si, ZnS, InSb, PbS, PbSe and TlCl are shown graphically.

537.311.33 **1078**

Surface Potential and Surface Charge Distribution from Semiconductor Field Effect Measurements.—W. L. Brown. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 590–591.) "It is possible from measurements of the change in conductance of a semiconductor with application of an electric field normal to its surface to determine both the electrostatic potential of the surface and the distribution of charge in surface states. Such determinations depend upon the uniqueness of the minimum in conductance which can be observed in these experiments, and its independence of the surface state charge."

537.311.33 **1079**

Ambipolar Thermodiffusion of Electrons and Holes in Semiconductors.—P. J. Price. (*Phil. Mag.*, Nov. 1955, Vol. 46, No. 382, pp. 1252–1260.) If a temperature gradient is maintained in a semiconductor then, since the equilibrium concentrations of electrons and holes increase with temperature, there will be a concentration gradient of both in the direction of the temperature gradient and a diffusion of both down this gradient ('ambipolar thermodiffusion'). A formula is derived for the magnitude of this effect and is used to determine the electronic contribution to the thermal conductivity and to the Nernst effect.

537.311.33 **1080**

An Easy Derivation of the Hole Lifetime in an *n*-Type Semiconductor with Acceptor Traps.—F. W. G. Rose & D. J. Sandiford. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 894–897.) The relations between the constants of recombination, generation and the mass-action laws are described and used for the calculation of hole lifetime in the case of steady-state injection, the concentrations of electrons and holes being assumed sufficiently low for Boltzmann statistics to apply. The result agrees with that given by Shockley & Read (420 of 1953). Lifetime at the commencement of injection is different from the steady-state value.

537.311.33 **1081**

The Use of a Modulated Light Spot in Semiconductor Measurements.—D. G. Avery & J. B. Gunn. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 918–921.) Modifications to the theory of the 'travelling-light-spot' method for the measurement of minority-carrier lifetime τ, which become necessary when the light spot is intensity modulated at a frequency $\omega/2\pi$, are discussed and experimentally verified. A necessary condition for accurate determinations is $\omega^2\tau^2 \ll 1$. Measurement of the phase of the collector signal as well as its amplitude enables the diffusion constant, and hence the drift mobility, of minority carriers to be determined directly.

537.311.33 : 535.215 **1082**

Method for determining the Mobility of Minority Current Carriers injected by Light.—S. M. Ryvkin & R. V. Khar'yuzov. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 563–568.) A detailed description of the apparatus is given and results of measurements are presented, including a number of oscillograms. A comparison of the results obtained with those published in the literature indicates that the method can be applied with advantage to investigations of the photoelectric properties of semiconductors.

537.311.33 : 537.32 : 546.873.241 **1083**

Investigation of the Thermoelectric Properties of Bismuth Telluride.—R. M. Vlasova & L. S. Stil'bans. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 569–576.) Report of an extensive investigation of the dependence of the thermo-e.m.f., electrical conductivity, concentration and mobility of current carriers of Bi_2Te_3 on temperature and on departure from stoichiometric composition.

537.311.33 : 537.533 **1084**

The Effect of Field Emission on the Behaviour of Semiconductor Contacts.—R. W. Sillars. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 881–893.) Quite a low potential across a semiconductor contact

may be sufficient to produce field emission around the area of contact. This condition is investigated theoretically and experimentally for semiconductors with negligible surface barrier; the current due to field emission varies as the square or three-halves power of the applied voltage. Similar effects are found with metals which are not quite in contact.

537.311.33 : 546.28 **1085**

Lifetime of Electrons in *p*-Type Silicon.—G. Bemski. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 523–524.) Measurements of the temperature variation of the lifetime of electrons in the vicinity of a *p-n* junction give results consistent with theory developed by Hall (3453 of 1952) and Shockley & Read (420 of 1953), assuming the level of recombination centres to be 0·2 eV above the valence band.

537.311.33 : 546.28 **1086**

Broadening of Impurity Levels in Silicon.—M. Lax & E. Burstein. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 592–602.) Calculations of infrared absorption based on a hydrogen-type energy-level scheme are compared with experimental results on boron-doped Si. Results confirm the hypothesis that the broadening of absorption lines observed as temperature increases from that of liquid helium to that of liquid nitrogen is due to the interaction of trapped electrons with acoustic lattice vibrations.

537.311.33 : 546.28 **1087**

Trapping of Minority Carriers in Silicon: Part 2 —*n*-Type Silicon.—J. R. Haynes & J. A. Hornbeck. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 606–615.) Complementary investigation to that described previously [2013 of 1955 (Hornbeck & Haynes)]. Evidence is obtained of hole trapping at two or more levels; the heights of the trap levels deduced from photoconductivity decay curves for a range of temperatures are consistent with accepted values of the energy gap.

537.311.33 : 546.28 : 535.37 **1088**

Visible Light from a Silicon *p-n* Junction.—R. Newman. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 700–703.) "When low-voltage silicon *p-n* junctions are biased in the reverse direction to breakdown, visible light is emitted from the junction region. The effects of surface treatment on the phenomenon are discussed. Two typical light output *vs* reverse current curves are shown. A typical spectral distribution curve in the 1·8–3·4 eV range is shown. The observations suggest that the light results from a radiative relaxation mechanism involving the high-energy carriers produced in the avalanche breakdown process."

537.311.33 : 546.28 : 621.396.822 **1089**

The Effect of Illumination on the Excess Noise of Silicon Filaments.—C. A. Hogarth & W. Bardsley. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 968–970.) Experiments indicate that the excess noise in Si filaments due to trapping effects is reduced by irradiation with white light. This is interpreted as showing that the free minority carriers produced by the absorbed light keep the traps occupied and so reduce their effectiveness.

537.311.33 : 546.289 **1090**

Precipitation of Copper in Germanium.—R. A. Logan. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 615–617.) "The density of dislocations is shown to have a marked effect on the rate of anneal of copper in germanium. At 500°C samples containing high dislocation density ($\sim 10^6$/cm²) anneal in about 1 hour in contrast to material of low dislocation density ($\sim 10^4$/cm²) which requires about 24 hours. When copper-doped germanium is cooled from a high temperature in regions of high dislocation density, significant precipitation occurs in a cooling cycle of only a few seconds. In this case, in order to prevent precipitation the sample must be quenched from the high temperature in a time of the order of 0·1 second."

537.311.33 : 546.289 **1091**

Properties of Germanium Doped with Manganese.—H. H. Woodbury & W. W. Tyler. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 659–662.) "The temperature dependence of the electrical resistivity and Hall coefficient in *p*- and *n*-type manganese-doped germanium crystals indicates that manganese introduces two acceptor levels in germanium at $0{\cdot}16 \pm 0{\cdot}01$ eV from the valence band and $0{\cdot}37 \pm 0{\cdot}02$ eV from the conduction band. The distribution coefficient for manganese in germanium is $(1{\cdot}0 \pm 0{\cdot}2) \times 10^{-5}$. Comparison is made with other fourth-row metals (V, Fe, Co, and Ni) as impurities in germanium."

537.311.33 : 546.289 **1092**

Classical Theory of Cyclotron Resonance for Holes in Ge.—J. M. Luttinger & R. R. Goodman. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 673–674.)

537.311.33 : 546.289 **1093**

Observation of Quantum Effects in Cyclotron Resonance [in Ge].—R. C. Fletcher, W. A. Yager & F. R. Merritt. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 747–748.) Observations of new cyclotron resonance lines at very low temperatures are interpreted as confirming theoretical predictions by Luttinger & Kohn (2316 of 1955).

537.311.33 : 546.289 **1094**

Restoration of Resistivity and Lifetime in Heat Treated Germanium.—R. A. Logan & M. Schwartz. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1287–1289.) "Experiments are described in which minority carrier lifetime and resistivity of germanium are altered by the addition of copper by diffusion, under conditions where extraneous chemical contamination is minimized. This copper is then gettered by heating the samples in contact with liquid lead or gold, and the resistivity and lifetime are substantially restored. The gettering process is interpreted in terms of the low distribution coefficient of copper in the ternary system which copper and germanium form with the getter."

537.311.33 : 546.289 **1095**

The Influence of Pressure on Metal/Germanium Contacts.—J. Lees & S. Walton. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 922–928.) Variation of the resistance of Ge with pressure is measured by comparing the areas of these contacts as given by electrical and by optical methods.

537.311.33 : 546.289 **1096**

Some Measurements connected with Carrier Deficit Phenomena in Germanium.—A. Many, D. Gerlich & E. Harnik. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 970–972.) Carrier exclusion was studied in *n*-type Ge filaments composed of two sections, one containing a higher proportion of donor impurities than the other, separated by a sharp transition region. Results are in accordance with theory.

537.311.33 : 546.289 : 535.215 **1097**

Temperature Dependence of Photocurrent in Ge *p-n* Junctions.—R. Wiesner & E. Groschwitz. (*Z. angew. Phys.*, Oct. 1955, Vol. 7, No. 10, pp. 496–499.) Measurements were made of the photocurrent at temperatures between 10° and 60°C; results are consistent with the recombination mechanism proposed by Hall (3453

of 1952), the temperature dependence being determined mainly by the carrier diffusion length. The production of carriers by the illumination is nearly independent of temperature. With the specimens investigated, surface recombination contributed little to the temperature variation of the photocurrent, hence the problem could be treated with sufficient accuracy as unidimensional.

537.311.33 : 546.289 : 538.614 **1098**

Faraday Effect in Germanium at Room Temperature.—R. R. Rau & M. E. Caspari. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 632–639.) Room-temperature measurements were made of the Faraday rotation of plane-polarized microwaves traversing 4-mm-thick samples of Ge inserted in a circular waveguide; for a longitudinal magnetic field of 1 400 G the angle of rotation is about 3°. Values of 3 780 and 3 300 cm/s per V/cm were deduced for the electron and hole mobilities in *n*- and *p*-type specimens respectively, based on analysis using the Drude-Zener model. For small losses, the ellipticity of the polarization of the transmitted wave is proportional to the relaxation time.

537.311.33 : 546.289 : 548.0 **1099**

Some Aspects of Slip in Germanium.—R. G. Treuting. (*J. Metals, N.Y.*, Sept. 1955, Vol. 7, No. 9, Section 2, pp. 1027–1031.) Experiments are reported indicating that slip in Ge crystals subjected to tension at 600°C is in the < 100 > direction.

537.311.33 : 546.289 : 621.317.331 **1100**

Surface Preparation and Resistivity Measurements on Semiconductor Crystals.—R. Manfrino. (*Alta Frequenza*, Aug./Oct. 1955, Vol. 24, Nos. 4/5, pp. 390–420.) The main chemical and electrolytic etching processes suitable for Ge single crystals are described; micrographs illustrating results are reproduced. Apparatus for resistivity measurements by the four-probe method [1502 of 1954 (Valdes)] is described. A resistivity map obtained with a crystal surface of area 150 mm² is shown.

537.311.33 : 546.289 : 621.396.822 **1101**

Hall Effect Noise.—J. J. Brophy & N. Rostoker. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 754–756.) Hall-effect measurements were made on Ge 'bridge' specimens exhibiting excess noise with the usual $1/f$ spectrum. A magnetic-field-dependent noise voltage was observed; this is interpreted as indicative of carrier density fluctuations.

537.311.33 : 546.3.171 **1102**

Production of Metal Nitrides by Glow Discharge, and some of their Properties.—W. Janeff. (*Z. Phys.*, 26th Oct. 1955, Vol. 142, No. 5, pp. 619–636.) The preparation of nitrides of Ag, Cu, Zn, Cd, Sb, Bi, Pb, Sn, Fe and Ni and measurements of their resistivities are described in detail. The temperature coefficient of resistance was also determined. No photoelectric effect was observed.

537.311.33 : 546.361.31 **1103**

Conductance Mechanisms and the Thermal Transition in Caesium Chloride.—W. W. Harpur & A. R. Ubbelohde. (*Proc. roy. Soc. A*, 8th Nov. 1955, Vol. 232, No. 1190, pp. 310–319.)

537.311.33 : 546.46.814 **1104**

Electrical and Optical Properties of Intermetallic Compounds: Part 4—Magnesium Stannide.—R. F. Blunt, H. P. R. Frederikse & W. R. Hosler. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 663–666.) Measurements over a temperature range indicate that the value of the energy gap is 0·33 eV at 0°K, and room-temperature mobilities are 320 and 260 cm/s per V/cm for electrons and holes respectively. Appreciable photoconductivity is observed at 85° and 5°K. Part 3: 1405 of 1955 (Blunt et al).

537.311.33 : 546.47-31 **1105**

The Electrical Conductivity at the Surface of Zinc Oxide Crystals.—G. Heiland. (*Z. Phys.*, 15th Oct. 1955, Vol. 142, No. 4, pp. 415–432.) Continuation of experiments reported previously (159 of 1955). The effects of exposure to an oxygen atmosphere and to light and electron irradiation were studied using single-crystal specimens. Both reversible and irreversible variations of conductivity are produced by irradiation at low temperature; this is interpreted as indicating that thin surface layers are effective in absorbing the radiation as well as in the oxygen interaction.

537.311.33 : 546.621.86 **1106**

Effect of Impurities on the Electrical Conduction Mechanism of AlSb.—A. R. Regel' & M. S. Sominski. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 768–770.) Experimental evidence shows that an admixture of Ge does not alter the conduction mechanism of AlSb while admixtures of Sn, Pb, As, Bi, Se and Te transform it into *n*-type. The rectifying properties of AlSb are also greatly affected by impurities. A theoretical interpretation of the results is presented.

537.311.33 : [546.682.86 + 546.681.86 **1107**

Nuclear Magnetic Resonance in Semiconductors: Part 1—Exchange Broadening in InSb and GaSb.—R. G. Shulman, J. M. Mays & D. W. McCall. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 692–699.) Experimental work is reported.

537.311.33 : 546.682.86 **1108**

Plasma Resonance in Crystals: Observations and Theory.—G. Dresselhaus, A. F. Kip & C. Kittel. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 618–625.) Observations are reported of magnetic resonance observed in *n*-type InSb at 9 and 24 kMc/s, at temperatures of 4° and 77°K. Theory presented previously in relation to resonance in Si and Ge (2995 of 1955) is extended to deal with this case. The influence of specimen shape and the possibility of detecting minority-carrier cyclotron resonance in the presence of a majority-carrier plasma are examined and eddy-current effects are discussed.

537.311.33 : 546.817.221 : 621.396.822 **1109**

Measurements of Current Noise in Lead Sulphide at Audio Frequencies.—D. Barber. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 898–907.) The mean square noise voltage per unit bandwidth, v_n^2, was found to vary as the square of the exciting current and to increase with decreasing frequency in a manner which varied from cell to cell, being directly dependent on cell resistance. Temperature and illumination affected v_n^2 only through their effect on resistance.

537.311.33 : [546.873.231 + 546.873.241 **1110**

Diffusion of Tin and Antimony in the Semiconducting Compounds Bi_2Se_3 and Bi_2Te_3.—B. Boltaks. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 767–768.) Experimental data are presented graphically. The activation energy in the case of Sb is two or three times greater than in the case of Sn.

537.311.33 : 621.396.822 **1111**

Relative Influence of Majority and Minority Carriers on Excess Noise in Semiconductor Filaments.—L. Bess. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1377–1381.) "An experiment has been devised whereby excess noise is measured along various different directions in a germanium filament after the directions of current flow for the majority and minority

carriers had been altered by a magnetic field. From this experiment it is possible to determine that whereas shot noise is caused by both majority and minority carrier fluctuation, $1/f$ noise is essentially produced only by majority carrier fluctuation."

537.323 : 546.56-1 **1112**

Effect of Point Imperfections on the Electrical Properties of Copper: Part 2—Thermoelectric Power.—F. J. Blatt. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 666–670.) Calculations are presented of the variation of thermoelectric power due to the presence of interstitials and vacancies and small concentrations of As. Part 1: 790 of March.

538.214 : 546.26-1 **1113**

Theory of the Magnetic Susceptibility of Graphite.—J. E. Hove. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 645–649.)

538.22 **1114**

Neutron Diffraction Study of the Magnetic Properties of the Series of Perovskite-Type Compounds $[(1-x)$ La, xCa$]$ MnO_3.—E. O. Wollan & W. C. Koehler. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 545–563.) "This series of compounds exhibits ferromagnetic and antiferromagnetic properties which depend upon the relative trivalent and tetravalent manganese ion content. The samples are purely ferromagnetic over a relatively narrow range of composition ($x \sim 0{\cdot}35$) and show simultaneous occurrence of ferromagnetic and antiferromagnetic phases in the ranges ($0 < x < 0{\cdot}25$) and ($0{\cdot}40 < x < 0{\cdot}5$). Several types of antiferromagnetic structures at $x = 0$ and $x > 0{\cdot}5$ have also been determined." The results are in good agreement with Goodenough's predictions (1115 below).

538.22 **1115**

Theory of the Role of Covalence in the Perovskite-Type Manganites [La, M(II)] MnO_3.—J. B. Goodenough. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 564–573.) The structure of these manganites is studied using the concept of semicovalent exchange [3016 of 1955 (Goodenough & Loeb)]. Predicted properties are consistent with experimental results (e.g. 1114 above).

538.22 **1116**

Magnetic Moment Arrangements and Magnetocrystalline Deformations in Antiferromagnetic Compounds.—Yin-Yuan Li. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 627–631.)

538.22 **1117**

Considerations on Double Exchange.—P. W. Anderson & H. Hasegawa. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 675–681.) Calculations are presented of interactions between magnetic ions, of the type discussed by Zener (2441 of 1951).

538.22 : 621.318.134 **1118**

Properties of Lithium Ferrite $FeLiO_2$.—R. Collongues. (*C. R. Acad. Sci., Paris*, 28th Nov. 1955, Vol. 241, No. 22, pp. 1577–1580.) Structural changes observed at temperatures up to 670°C are described.

538.22 : 621.318.134 **1119**

Micrographic Study of the Cubic→Quadratic Transformation in Copper Ferrite.—I. Behar. (*C. R. Acad. Sci., Paris*, 28th Nov. 1955, Vol. 241, No. 22, pp. 1580–1581.)

538.22 : 621.318.134 **1120**

Influence of Substitutions on Quadratic Deformation in Copper Ferrite and Chromite.—C. Delorme. (*C. R. Acad. Sci., Paris*, 28th Nov. 1955, Vol. 241, No. 22, pp. 1588–1589.)

538.221 **1121**

A Simple Method for rendering Elementary Magnetic Domains Visible by use of Dry Powder.—W. Andrä & E. Schwabe. (*Ann. Phys., Lpz.*, 15th Oct. 1955, Vol. 17, No. 1, pp. 55–56.) The specimen is exposed to smoke from ignited iron pentacarbonyl.

538.221 **1122**

Solutions of the Equations of Ferrimagnetic Resonance.—B. Dreyfus. (*C. R. Acad. Sci., Paris*, 7th Nov. 1955, Vol. 241, No. 19, pp. 1270–1272.) A detailed study is made of the four solutions of the resonance equation derived previously (185 of January) in the light of the fact that only two resonances are observed experimentally and one of these is generally very weak [2335 of 1955 (McGuire)].

538.221 **1123**

Irreversible Magnetic After-Effect and its Influence on the Form of the Magnetization Curve.—O. Yamada. (*Z. Phys.*, 12th Sept. 1955, Vol. 142, No. 2, pp. 225–240.) Results of an experimental investigation on alnico (24% Co; 13·5% Ni; 8·5% Al; 3% Cu; 51% Fe) are reported and discussed.

538.221 **1124**

Results and Problems of the Quantitative Theory of Coercive Force.—R. Brenner. (*Z. angew. Phys.*, Oct. 1955, Vol. 7, No. 10, pp. 499–507.) A critical survey of published theoretical work on the nature of the coercive force in ferromagnetic materials, in relation to physical and practical aspects.

538.221 **1125**

Theory of Remagnetization of Thin Tapes.—H. Ekstein. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1342–1343.) Analysis based on domain-wall displacements is given for the reversal of magnetization of ferromagnetic tapes with rectangular hysteresis loops, subjected to an external field parallel to the surface.

538.221 **1126**

Influence of Pulsed Magnetic Fields on the Reversal of Magnetization in Square-Loop Metallic Tapes.—D. S. Rodbell & C. P. Bean. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1318–1323.) Report of experiments confirming results obtained previously [1706 of 1955 (Bean & Rodbell)] and illuminating the process of domain formation. The 'intrinsic mobility' of domain walls is evaluated; for a particular permalloy specimen the value is about 100 cm/s per oersted.

538.221 **1127**

Electrical Analog of the Eddy-Current-Limited Domain-Boundary Motion in Ferromagnetics.—G. Brouwer. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1297–1301.) When a ferromagnetic material is magnetized by domain-boundary displacement, the dispersion region of the permeability/frequency curve shifts towards lower frequencies with increasing domain size, in consequence of the inhomogeneous distribution of the permeability at the domain boundaries. This corresponds to the eddy-current phenomenon in laminated materials. Analysis based on equivalent networks is presented for some idealized cases. Successive stages in the magnetization process are illustrated by field maps with boundary movements indicated.

538.221 **1128**

Hysteresis Loops of Mixtures of Ferromagnetic Micropowders.—C. P. Bean. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1381–1383.) The mixtures considered are dilute compacts with $< 1\%$ of the volume occupied by the ferromagnetic powders, so that the total

magnetization can be determined simply from the magnetization of the constituents. The latter comprise particles in three different size ranges, large (multi-domain), medium (single-domain) and small (single-domain 'super-paramagnetic'). Experimental results are discussed in relation to theories regarding the coercive force of such mixtures.

538.221 **1129**

The Remanent Magnetization of Haematite Powders.—E. P. Wohlfarth. (*Phil. Mag.*, Nov. 1955, Vol. 46, No. 382, pp. 1155–1164.) "Calculations are described of the remanent magnetization and the remanence after demagnetization as a function of field strength for powders of haematite, αFe_2O_3. The calculations are based on the assumptions that the powder particles are single domains and that their hysteretic properties are due to magnetocrystalline anisotropy with threefold symmetry in the basal crystal plane. The calculations are intended for eventual comparison with experiments now in progress."

538.221 **1130**

The Thermal Effects associated with the Magnetization of High-Coercivity Materials.—L. F. Bates & A. W. Simpson. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 849–858.) Experiments with alloys of the Fe_2NiAl type, over a field range of 4 000 oersteds, give results in accordance with the theory advanced by Stoner & Rhodes (*Phil. Mag.*, May 1949, Vol. 40, No. 304, pp. 481–522).

538.221 + 549.514.51] : 534.22-8 **1131**

Variation of Elastic-Wave Velocity with Frequency in Fused Quartz and Armco Iron.—D. S. Hughes & J. M. Kennel. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1307–1309.) Using small cylindrical samples specially built up to transmit only torsional waves, the propagation velocity was observed to be constant within $\pm$ 1 m/s over the frequency range 0·6–3 Mc/s for fused quartz; for armco the velocity was constant within $\pm$ 2 m/s from 0·5 to 1·5 Mc/s and decreased by about 10 m/s between 1·5 and 3 Mc/s.

538.221 : 539.234 **1132**

Magnetic Domains in Thin Films of Nickel-Iron.—C. A. Fowler, Jr, & E. M. Fryer. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 746–747.) Photographs of the domain pattern on both faces of an evaporated film are reproduced.

538.221 : 621.318.132 **1133**

Relation of Magnetic Characteristics of Magnetically Soft Alloys to Thickness of Lamination.—E. I. Gurvich & E. Kondorski. (*C. R. Acad. Sci. U.R.S.S.*, 1st Oct. 1955, Vol. 104, No. 4, pp. 530–532. In Russian.) Experimental results indicate that the change in the frequency characteristics of the permeability and loss angle with change in the thickness of the specimen is probably due to a greater penetration, during the heat treatment, of impurities from the surface into the material in thinner specimens. Molybdenum permalloy and 50% permalloy were investigated.

538.221 : 621.318.134 **1134**

Ferrimagnetic Resonance in Single Crystals of Manganese Ferrite.—J. F. Dillon, Jr, S. Geschwind & V. Jaccarino. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 750–752.) Report of experiments at frequencies of 5·9, 9·3 and 24 kMc/s, and at temperatures up to 300°K. Resonance curves and line-width/temperature characteristics are shown.

538.221 : 621.318.134 **1135**

Transient Phenomena in a Ferrite.—S. Matz. (*Rev. gén. Élect.*, Oct. 1955, Vol. 64, No. 10, pp. 491–509.) Detailed account of an investigation, previously described briefly (3605 of 1954), of the complex-permeability variations of ferrites in a h.f. magnetic field. Results are discussed in relation to theory and measurements of magnetic after-effect.

538.221 : 621.318.134 **1136**

Low-Magnetic-Saturation Ferrites for Microwave Applications.—L. G. Van Uitert. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1289–1290.) Values of Curie temperature, coercive force, magnetic saturations at 25°C, and initial permeability at 0·1 Mc/s are given for six MgAlMn ferrites.

538.652 **1137**

Calculation of Magnetostriction Constants for Nickel.—G. C. Fletcher. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431A, pp. 1066–1071.) Calculations for Ni at 0°K, based on the collective electron model, give values of the magnetic constants rather larger than the latest figures obtained experimentally at 120°K.

548.0 : 537.311.33 **1138**

Symmetry Properties of the Energy Bands of the Zinc Blende Structure.—R. H. Parmenter. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 573–579.) Analysis is based on group theory, first excluding and then including spin-orbit coupling. Character tables and compatibility tables are presented. The degeneracies and gradients of the various possible energy bands are studied at lines and points of symmetry in the Brillouin zone. The results are compared with those for the equivalent energy bands in crystals of diamond structure.

548.0 : 537.311.33 **1139**

Spin-Orbit Coupling Effects in Zinc Blende Structures.—G. Dresselhaus. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 580–586.) "Character tables for the 'group of the wave vector' at certain points of symmetry in the Brillouin zone are given. The additional degeneracies due to time reversal symmetry are indicated. The form of energy *vs* wave vector at these points of symmetry is derived."

548.5 **1140**

Single Crystals with Pure Surfaces.—E. Menzel, W. Stössel & M. Otter. (*Z. Phys.*, 1st Oct. 1955, Vol. 142, No. 3, pp. 241–244.) A method is outlined for producing spherical single crystals of metals by congelation from the molten state on to a plane base material in a vacuum.

548.5 : 669.046.54/.55 **1141**

Contribution to Mathematics of Zone Melting.—L. Burris, Jr, C. H. Stockman & I. G. Dillon. (*J. Metals, N.Y.*, Sept. 1955, Vol. 7, No. 9, Section 2, pp. 1017–1023.)

548.5 : 669.046.54/.55 : 537.311.33 **1142**

Temperature Gradient Zone Melting.—W. G. Pfann. (*J. Metals, N.Y.*, Sept. 1955, Vol. 7, No. 9, pp. 961–964.) "Under certain conditions, a molten zone can be made to move through a solid by impressing a stationary temperature gradient across the solid. This phenomenon can be utilized in fabricating semiconductive devices, growing single crystals, joining, boring fine holes in solids, measuring diffusivities in liquids, small scale alloying, and purification. Fundamentals and exemplary applications are outlined."

621.315.56 : 621.315.616 **1143**

Rubber as an Electrical Conductor in Engineering: Properties, General and Special Applications.—S. de Meij. (*Bull. schweiz. elektrotech. Ver.*, 29th Oct. 1955, Vol. 46, No. 22, pp. 1067–1069.) The electrical and mechanical properties of rubber containing furnace black are briefly reviewed. Applications mentioned include use in antistatic devices, cable sheaths, panel heating, noise-free cables and electromechanical transducers. Use of conducting rubber for semiconductor diodes and triodes is suggested, but no details are given.

621.315.614.64 **1144**

Acetylized Paper as an Insulating Material in Electrical Engineering.—W. Dieterle. (*Bull. schweiz. elektrotech. Ver.*, 29th Oct. 1955, Vol. 46, No. 22, pp. 1045–1065.) A comprehensive survey is presented of the electrical properties of paper treated with acetic acid. The treatment reduces the hygroscopicity. Impregnation with chlorinated oils of high dielectric constant further improves the insulating qualities. 26 graphs, 3 tables of properties of papers, fibres and oils, and 43 references are given.

621.315.616 **1145**

The Mechanical Engineering of Dielectrics.—B. Maxwell. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, pp. 870–873.) The mechanical properties of polymeric plastics are discussed; the importance of their variation with time and with temperature is illustrated by results of measurements.

621.315.616 **1146**

Electric Strength of Irradiated Polythene.—K. H. Stark & C. G. Garton. (*Nature, Lond.*, 24th Dec. 1955, Vol. 176, No. 4495, pp. 1225–1226.) Measurements were made at temperatures up to 220°C on moulded disks recessed to a thickness of about 50 μ, irradiated with 4-MeV electrons. Results are compared with those obtained by Bird & Pelzer for unirradiated material (1696 of 1949).

621.318.2 : 621.385.029.6 **1147**

Permanent Magnets for Microwave Electron Valves.—de Bennetot. (See 1254.)

621.357 **1148**

Micromachining with Virtual Electrodes.—A. Uhlir, Jr. (*Rev. sci. Instrum.*, Oct. 1955, Vol. 26, No. 10, pp. 965–968.) An electrolytic etching method is described which has been used to drill very small holes in Ge, Mo, Fe, etc., and to plate small areas. The technique involves use of a glass tube drawn to a fine tip to localize the current.

537.311.33 **1149**

Poluprovodniki v Sovremennoi Fizike (Semiconductors in Contemporary Physics). [Book Review]—A. F. Ioffe. Publishers: Izd. A.N. S.S.S.R. (Acad. Sci. U.S.S.R.), Moscow-Leningrad, 1954, 355 pp., 17r.60k. (*Uspekhi fiz. Nauk*, Sept. 1955, Vol. 57, No. 1, pp. 165–169.) A monograph written for physicists, chemists and engineers. Chapters are included on (*a*) solid electrolytes, (*b*) metals, (*c*) electronic semiconductors, (*d*) quantum theory of semiconductors, (*e*) physical phenomena in semiconductors, and (*f*) experimental results.

MATHEMATICS

512 **1150**

Vectors, Matrices and Determinants, Tensors.—R. Fortet. (*Bull. Soc. franç. Élect.*, Oct. 1955, Vol. 5, No. 58, pp. 710–726.) An introductory article for electrical engineers.

517.522.2 **1151**

A Simple Method for the Numerical Calculation of Time Functions for Given Broken Rational Transform Functions.—R. Hofmann & W. Walcher. (*Arch. elekt. Übertragung*, Oct. 1955, Vol. 9, No. 10, pp. 475–478.) The method described is useful in analysis involving Laplace transforms. The required time function is presented in the form of a rapidly converging power series.

517.9 : 537.21 **1152**

Poisson's Partial Difference Equation.—Davies. (See 1019.)

MEASUREMENTS AND TEST GEAR

531.761 + 529.7 **1153**

Definition of the Second of Time.—G. M. Clemence. (*Nature, Lond.*, 24th Dec. 1955, Vol. 176, No. 4495, p. 1230.) Attention is directed to certain undesirable consequences involved in the adoption of a 'physical second' in place of the astronomical second [3686 of 1955 (Bullard)]. It is suggested that if a new physical unit is adopted it should be given a name other than 'second', to avoid confusion. See also 513 of February (Jones).

621.317.331 : 537.311.33 : 546.289 **1154**

Surface Preparation and Resistivity Measurements on Semiconductor Crystals.—Manfrino. (See 1100.)

621.317.335 : 621.315.61 **1155**

Measurement of ϵ' and tan δ of a Solid Dielectric at Centimetre Wavelengths in the Temperature Range from $-100°$ to $+100°$C.—P. F. Veselovski. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 601–609.) A new method is described in which use is made of a rectangular resonator designed for oscillations of the H_{10} type. The resonator consists of two waveguide sections separated by a sheet of mica and closed by movable pistons at the ends. Results of measurements on polythene and other insulating materials are given in tables and curves.

621.317.335 : 621.317.755 **1156**

A Precision Resonance Method for measuring Dielectric Properties of Low-Loss Solid Materials in the Microwave Region.—S. Saito & K. Kurokawa. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 35–42.) A disk sample is inserted into a cylindrical cavity resonator; the dielectric constant is found from the difference between the lengths for resonance with and without the sample, and the loss factor is found from the difference between the Q factors. Good precision is obtained by using a differentiated resonance curve as a frequency marker on the oscilloscope.

621.317.335.3 **1157**

The Measurement of Dielectric Constants of Liquids at Decimetre Wavelengths.—T. Jäkel. (*Ann. Phys., Lpz.*, 15th Oct. 1955, Vol. 17, No. 1, pp. 42–54.) Detailed description of a coaxial-line method in which the evaluation of the results does not involve transcendental functions.

621.317.336 **1158**

Reflection and Impedance Measurements by means of a Long Transmission Line.—J. C. van den Hoogenband & J. Stolk. (*Philips tech. Rev.*, May 1955,

Vol. 16, No. 11, pp. 309–320.) Description of a variable-frequency stationary-detector method using a line about 60 m long. Direct visual indication of matching is given by means of an oscilloscope. For quick measurements a wobbulator is used, for more accurate measurements a variable-frequency oscillator is preferred, in conjunction with a d.c. microammeter.

621.317.34 : 621.373.42.025.3 **1159**

Wide-Band Three-Phase *RC*-Generators for Complex Measurements of Two-Poles and Four-Poles.—G. Thirup. (*J. Brit. Instn Radio Engrs*, Dec. 1955, Vol. 15, No. 12, pp. 597–605.) "From a 3-phase *RC* oscillator two voltages are derived, the complex ratio of which can be varied. The complex ratio is independent of the frequency. The two voltages are used in a compensation circuit for measuring the parameters of two-poles and four-poles. Two equipments are described covering the frequency ranges 20 c/s–22 kc/s and 22 kc/s–10 Mc/s. The possible error is $\pm$ 0·5 dB and $\pm$ 2° in the frequency range 100 c/s–3 Mc/s. Outside this range the phase error may increase about 3 times while the amplitude error remains nearly the same."

621.317.715 **1160**

Very-High-Sensitivity Screened Galvanometer.—W. Meissner & R. Doll. (*Z. angew. Phys.*, Oct. 1955, Vol. 7, No. 10, pp. 461–468.)

621.317.722 **1161**

Design for a Sensitive Self-Recording Gold-Leaf Electroscope.—P. Goodman. (*J. sci. Instrum.*, Nov. 1955, Vol. 32, No. 11, pp. 439–440.) An electrode system is used such that the leaf deflection passes through 90° and the leaf then discharges; the output is in the form of voltage pulses whose frequency is proportional to current for low values and logarithmically related for higher values. Steady electron currents of the order of 10^{-14} A can be measured.

621.317.733 : 621.314.7 **1162**

A D.C. and A.C. Balance Detector with Automatic Protection from Overload.—C. Morton. (*J. sci. Instrum.*, Nov. 1955, Vol. 32, No. 11, pp. 437–439.) Two junction transistors in a balanced bridge circuit give a current gain of 50. The input resistance approaches infinity for input voltages $>$ 150 mV, thus providing automatic protection. For a.c. working the application of an auxiliary voltage of about 4 V, of the same frequency as the bridge voltage, gives a sensitivity of 15 mA/V (r.m.s.).

621.317.75.029.3 **1163**

Audio Frequency Spectrum Analyzer.—E. F. Feldman. (*Tele-Tech & Electronic Ind.*, Oct. 1955, Vol. 14, No. 10, pp. 78–81..135.) The heterodyne-type equipment described displays the Fourier analysis of complex waveforms, providing either logarithmic or linear frequency and amplitude indications. Points of the design are discussed, particularly the i.f. stages, the bandwidth of which is varied in synchronism with the log-frequency scan to maintain optimum resolution.

621.317.755 **1164**

Voltage Coincidence Oscilloscope.—R. J. D. Reeves. (*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 85–87.) A method of presenting multichannel displays on a single-beam c.r.o. uses a voltage-coincidence circuit in place of a Y amplifier, with a normal timebase voltage on the X plates. A number of co-phased outputs are taken from an independent a.f. oscillator and one of them is applied to the Y plates to give a full-scale deflection; the others are used as reference signals in the voltage-coincidence circuit to explore the waveforms under examination, a bright spot appearing on the screen whenever the two signals are equal. The method is not useful for very fast displays, and care is necessary to avoid erroneous interpretation of the display.

621.317.755 : 621.3.015.3 **1165**

New Circuits for Recurrent Surge Oscillography.—D. D. Davis. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, pp. 919–923.)

621.317.772 **1166**

Measuring Phase at R.F. and Video Frequencies.—Y. P. Yu. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 138–140.) A continuously variable delay line is used in conjunction with a balanced phase detector to indicate the phase difference between two input signals. The frequency range is 10 kc/s–20 Mc/s; a delay of 5×10^{-10} sec can be measured. Accuracy is within $\pm$ 0·1° of phase angle, or $\pm$ 1% of indicated time delay.

621.317.772.029.3 : 621.314.7 **1167**

Direct-Indicating Audio-Frequency Phase-Angle Meters using Transistors.—K. Homilius. (*Arch. tech. Messen*, Oct. 1955, No. 237, pp. 221–224.) Circuits are described based on the technique of converting the sinusoidal signals whose phase difference is unknown into constant-amplitude pulses. Use of both point-contact and junction transistors is indicated.

621.317.784 **1168**

Wattmeters.—H. D. Hawkes & A. H. M. Arnold. (*J. Instn elect. Engrs*, Nov. 1955, Vol. 1, No. 11, pp. 676–683.) A review of commercial instruments, including one torsion-head microwave type.

621.317 + 621.372].029.63/.64 **1169**

Schaltungstheorie und Messtechnik des Dezimeter- und Zentimeterwellengebietes. [Book Review]—Weissfloch. (See 1015.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.1-8 : 621.9 **1170**

Ultrasonic Machining of Brittle Materials.—M. S. Hartley. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 132–135.) High-speed cutting is achieved by means of a correctly shaped tool vibrating above the specimen at a frequency of 25 kc/s. The tool face and the specimen do not come into contact; an abrasive powder in a liquid suspension is fed between the two and cutting is done by impact of the powder on the specimen surface.

550.837 **1171**

Geophysical Prospection of Underground Water in the Desert by means of Electromagnetic Interference Fringes.—M. A. H. El-Said. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 24–30.) A variable-frequency and a variable-distance method are described. Interference patterns obtained at two places in the Egyptian deserts are shown; results are in good agreement with information regarding the water table obtained from boring.

621-52 : 621.9 **1172**

An Electronically Controlled Machine Tool.—(*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, p. 37.) A fully automatic copy milling machine for the production of cams is described. Coded design information is fed on plastic tape to a control unit and information

store which also contains provision for enabling smooth profile curves to be deduced from a relatively small number of stored marker points.

621-526(083.7) **1173**

I.R.E. Standards on Terminology for Feedback Control Systems, 1955.—(*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 107–109.) Standard 55 I.R.E. 26. S2.

621.365.5 : 621.385 **1174**

Brown Boveri Transmitting and Rectifier Tubes in Industrial Generators for R.F. Heating.—R. Hübner. (*Brown Boveri Rev.*, Sept. 1955, Vol. 42, No. 9, pp. 370–387.) Brief illustrated descriptions are given of induction and dielectric heating apparatus for various purposes.

621.374.3 : 621.316.86 : 77 **1175**

Precision Photographic Timer.—J. G. Thomason. (*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 71–74.) An electronic timing circuit based on the Miller integrator is described. Compensation for variations in mains voltage is obtained by use of a feed resistor in which the current passed varies approximately as the fifth power of the applied voltage.

621.384.613 **1176**

Energy Stability of the 22-MeV Betatron at the University of Illinois.—B. M. Spicer & A. S. Penfold. (*Rev. sci. Instrum.*, Oct. 1955, Vol. 26, No. 10, pp. 952–953.) The greatest energy fluctuation observed over a period of eighteen months was 40 keV at 17 MeV.

621.385.83.032.2 **1177**

Some Anomalous Emission Effects in Low-Energy Electron Beams.—W. W. H. Clarke & L. Jacob. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 805–816.) Cathode emission in a specially made electron gun, using accelerating voltages in the range 18–30 V, was found to vary in a periodic manner over the cathode surface, variations being greatest in the central region where the emission pattern was critically dependent on accelerating voltage and on cathode temperature. Variation of total emission was also periodic. The wavelength of the standing-wave pattern across the emitter was 0·01 m.n; the electrons are assumed to oscillate in the field resulting from the effects of the initial velocities and the space charge.

621.385.833 **1178**

An Investigation of the Electron-Optical Properties of Straight Magnetic Gaps.—S. N. Baranovski, D. L. Kaminski & V. M. Kel'man. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 610–624.) The system considered consists of two magnetic pole pieces greatly extended in one direction; electrons are subjected to the action not of the field in the gap but of the 'dissipation field' in front of it. A theoretical as well as experimental investigation into the operation of the system is presented.

621.385.833 **1179**

The Scanning Electron Microscope and its Fields of Application.—K. C. A. Smith & C. W. Oatley. (*Brit. J. appl. Phys.*, Nov. 1955, Vol. 6, No. 11, pp. 391–399.) The advantages of the scanning electron microscope, due especially to the large angles of incidence and reflection which can be used, are discussed and examples are given of applications for which the conventional electron microscopes are unsuitable. Bombardment of the specimen is much less severe than with conventional types. A resolution of 200 Å has been attained and a value of < 100 Å may be attainable.

621.385.833 **1180**

A Possible Chromatic Correction System for Electron Lenses.—G. D. Archard. (*Proc. phys. Soc.*, 1st Nov. 1955, Vol. 68, No. 431B, pp. 817–829.) It is shown that a combination of two two-pole groups of electrodes can provide axial chromatic correction in one plane. Applications to practical correction systems are discussed and curves are given for the chromatic and focal properties of the corrective electrode group considered.

621.385.833 **1181**

Chromatic Aberration and Aperture Error of Cylindrical Electron-Optical Lenses.—M. Rheinfurth. (*Optik, Stuttgart*, 1955, Vol. 12, No. 9, pp. 411–416.) Expressions are derived for the two types of error, and it is shown that they cannot both be eliminated.

621.385.833 **1182**

Use of a Cylindrical Lens for reducing Image Distortion in Reflection Electron Microscopy.—C. Fert & B. Marty. (*C. R. Acad. Sci., Paris*, 21st Nov. 1955, Vol. 241, No. 21, pp. 1454–1456.)

621.385.833 : 535.767 **1183**

Theory and Technique of Electron-Microscope Stereograms.—(*Optik, Stuttgart*, 1954, Vol. 11, No. 12, pp. 562–577 & 1955, Vol. 12, No. 6, pp. 253–272.)

Part 1: 3657 of 1954.

Part 2: Errors in the Determination of Depth of Electron-Microscope Stereograms.—J. G. Helmcke & H. J. Orthmann.

Part 3: Methods for determining the Depth of Objects and Requirements for a Photogrammetric Apparatus.—J. G. Helmcke.

621.385.833 : 537.525 **1184**

Electric 'Microdischarges' in a Dynamic Vacuum.—Arnal. (See 1025.)

621.396.934 : 621.396.96 **1185**

Radar-Guided Missiles.—(*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 67–70.) A brief survey of the principles of command-guidance, homing and beam-riding control systems used with ground-to-air missiles.

621.396.934 : 621.398 **1186**

Fuel Cut-Off Control for Guided Missiles.—G. L. Zomber & D. Macmillan. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 126–127.) The input circuit of the control relay comprises a parallel-T network tunable over the range 88–154 c/s, and is designed for use with a radar beacon system. The operating potential of a neon-tube voltage regulator in the switching circuit is stabilized by radiation from a radium pellet.

621.398 **1187**

The New Centralized Telecontrol System on 175 c/s adopted by Électricité de France.—F. Cahen & H. Prigent. (*Rev. gén. Elect.*, Oct. 1955, Vol. 64, No. 10, pp. 475–484.)

621.384.6 **1188**

High-Energy Accelerators. [Book Review]—M. S. Livingston. Publishers: Interscience, New York and London, 1954, 157 pp., 26s. (*Phil. Mag.*, Nov. 1955, Vol. 46, No. 382, p. 1264.) Recommended as a useful introduction to and survey of particle accelerators.

PROPAGATION OF WAVES

538.566.2 : 551.510.535 **1189**

Reflection of a Plane Electromagnetic Wave from a Stratified Ionized Gas.—P. Poincelot. (*C. R. Acad. Sci., Paris*, 7th Nov. 1955, Vol. 241, No. 19, pp.

1272–1275.) Continuation of analysis presented previously (3725 of 1955). The conditions for total reflection are indicated and expressions are derived for the phase shift of the reflected wave and the group propagation time in terms involving the apparent height of reflection. Results are discussed briefly in relation to ionosphere soundings.

621.396.11 **1190**

Measurements of the Propagation Time of Standard Time Signals.—M. Boella & C. Egidi. (*Alta Frequenza*, Aug./Oct. 1955, Vol. 24, Nos. 4/5, pp. 309–338.) Report of experiments made in May 1951, using transmissions in both directions between Turin, Italy, and Beltsville, U.S.A. Because the signals become distorted during transmission, an arbitrary criterion must be adopted for the moment at which the signal is considered to be received. Various criteria are compared on the basis of a statistical analysis of results. With a series of about 60 observations in 1 min, the accuracy of the determination is within about 0·1 ms, using photographic technique. On comparing the results with data obtained by ionospheric soundings at points near the propagation path, the most probable number of hops is deduced to be 4 or 5, the corresponding single-hop distance being 1 670 or 1 340 km respectively. Discrepancies between this result and the values usually assumed are discussed.

621.396.11 : 537.56 **1191**

Theory of Radio Reflections from Electron-Ion Clouds.—V. R. Eshleman. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. AP-3, No. 1, pp. 32–39.) First-order approximations to the effects of size, shape and density on the reflecting properties of electron-ion clouds are obtained. For low-density clouds the reflection coefficients are determined by summation of the wavelets from individual ions; high-density clouds are treated as total reflectors at the critical-density radius.

621.396.11 : 551.510.535 **1192**

Wave Solutions for Critical and Near-Critical Coupling Conditions in the Ionosphere.—N. Davids & R. W. Parkinson. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 173–202.) "Principal dielectric axis co-ordinates are used to put the coupled wave equations for ionospheric propagation into a form which is suitable for an analysis of critical coupling. This approach removes the singularity formerly associated with critical coupling. The analysis is carried out through the second order and compared with some recent data on polarization. The results compare favourably for several ionospheric models considered. A satisfactory analysis of split echoes at 150 kc/s is developed."

621.396.11 : 551.510.535 **1193**

Observations of the Effects of Ionospheric Storms over a North Atlantic Circuit.—T. W. Bennington. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 235–243.) The median m.u.f. (i.e. the frequency up to which signals are propagated for 50% of a given period) for normal and disturbed conditions has been deduced from regular observations of signals from WWV, Washington, received at Tatsfield, England, over the period July–December 1953. The results show that disturbance of communications is most severe during the period 0700 to 1100 of any disturbed day. This agrees with the findings of Appleton & Piggott (2802 of 1952) from vertical-incidence data. The effect is also dependent on the normal value of m.u.f. for the time of day, being greater at night, particularly during winter when the normal m.u.f. is low.

621.396.11 : 551.510.535 **1194**

On the Variation of Ionospheric Absorption at Different Stations.—Piggott. (See 1051.)

621.396.11 : 551.510.535 **1195**

Selective Annotated Bibliography on Ionospheric Propagation.—M. Rigby & M. L. Rice. (*Met. Abstracts Bibliography*, April 1955, Vol. 6, No. 4, pp. 489–547.) Includes some 300 references covering the period 1902–1955.

621.396.11 : 551.594.6 **1196**

An Atmospherics Analyzer.—P. F. Smith. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. AP-3, No. 1, pp. 9–12.) A system is described which records the received atmospheric waveform and simultaneously derives a plot of the time intervals between peaks of the waveform/time curve, facilitating reduction of data relating to range and ionospheric layer height.

621.396.11 : 621.396.6 **1197**

Tests on Long-Range Decimetre-Wavelength Multiplex Links.—R. Goublin. (*Bull. Soc. franç. Élect.*, Oct. 1955, Vol. 5, No. 58, pp. 700–709.) Transmissions on frequencies in the band 450–470 Mc/s over distances from 50 to 100 km show ground losses varying from 6 to 36 dB for angles of diffraction from 0 to 25×10^{-3} rad. Over paths of 215 and 250 km, one at grazing incidence to a forest terrain and the other over line of sight, fading is found to be worse in summer than in winter, especially over the forest, but communication is possible for practically all the time with a 20-W transmitter and parabolic aerials. F.m. terminal equipment for permanent communication links is described.

621.396.11 : 621.396.67.012.12 **1198**

The Dependence of Meteoric Forward-Scattering on Antenna Patterns and Orientations.—C. O. Hines, P. A. Forsyth, E. L. Vogan & R. E. Pugh. (*Canad. J. Phys.*, Oct. 1955, Vol. 33, No. 10, pp. 609–610.) Radio waves of frequencies above accepted m.u.f. may be propagated by scattering either from ionospheric irregularities [2581 of 1952 (Bailey et al.)] or from meteor trails [e.g. 2117 of 1953 (Villard et al.)]. In any given set of observations the predominant mechanism depends on the aerial radiation pattern; directing the radiation off the transmitter-receiver axis favours the meteor-trail-scattering mechanism.

621.396.11.029.53/.55 **1199**

A Theoretical Model for High-Frequency Backscatter from the Sea Surface via the Ionosphere.—W. C. Hoffman. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 278–284.) The average far-zone backscattered power is computed for perfectly conducting doubly-trochoidal and doubly-sinusoidal surfaces (see also *Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 96–100). Either assumption gives results of the correct order of magnitude; from the nature of the problem, this is the best that can be expected. The doubly-sinusoidal surface leads to much more convenient computations.

621.396.11.029.55 **1200**

Arrival Angle of H.F. Waves.—A. F. Wilkins & C. M. Minnis. (*Wireless Engr*, Feb. 1956, Vol. 33, No. 2, pp. 47–53.) "Apparatus is described for measuring the angle of elevation of h.f. waves arriving at the ground after transmission by way of the ionosphere. The system involves the comparison of the amplitudes of the signals received by two vertically-spaced horizontal loop aerials at heights above the ground of about 33 metres and 12·5 metres. The comparison is effected by amplifying the signal e.m.fs in a twin-channel receiver and

applying the i.f. voltages to the deflecting plates of a cathode-ray oscilloscope. It is shown that, if a single ray is incident on the system, the e.m.fs produced in the two aerials are in phase irrespective of their height above ground, so that the corresponding oscilloscope pattern is a straight line, the slope of which is a simple function of the angle of elevation of the ray. Calibrations of the system over the band 10–20 Mc/s have shown that its behaviour is very close to that expected from the simple theory and that there is no noteworthy change in the calibration with azimuth. Methods of observation for the general case of the arriving signal consisting of more than one ray are considered."

621.396.11.029.55 : 551.510.535 **1201**

Azimuthal Fluctuations of the Direction of Arrival of Short Radio Waves.—W. Kronjäger & K. Vogt. (*Nachrichtentech. Z.*, Oct. 1955, Vol. 8, No. 10, pp. 537–540.) The directions of arrival of signals from Tangiers, Rio de Janiero, Buenos Aires, Osaka and Tokio, were measured at Eschborn. The frequencies were between 13 and 21 Mc/s and were in all cases below the m.u.f. The distribution of deviations was Gaussian; maximum fluctuations were $\pm 3°$ for 80% of the observations and $\pm 5°$ for 98%. Median directions of arrival for the first three stations coincided with the great-circle directions, but those for Osaka and Tokio deviated by 2° and 3° respectively, to the south. The aerial system comprised two rhombic aerials set at an angle of 9° to each other. Results are tabulated and presented graphically.

RECEPTION

621.396.82 : 551.594.6 **1202**

Atmospheric Noise Interference to Broadcasting in the 3-Mc/s Band at Poona.—S. V. C. Aiya & K. R. Phadke. (*J. atmos. terr. Phys.*, Oct. 1955, Vol. 7, Nos. 4/5, pp. 254–277.) Using an objective method previously described [257 of 1955 (Aiya)] systematic measurements were made daily from 1800 to 2300 I.S.T. throughout 1953; noise data required for the design of broadcast services are deduced. The results are compared with estimates of noise taken from *Nat. Bur. Stand. Circulars*, No. 462 and with experimental results given in *Radio Research Board Special Report* No. 26 [842 of 1954 (Horner)]; both of these tend to be low. An attempt is made to estimate noise levels from known thunderstorm data; reasonable agreement with measured values is obtained.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 **1203**

Calculation of the Spectra of Modulated Pulse Trains.—M. Sánchez & F. Popert. (*Arch. elekt. Übertragung*, Oct. 1955, Vol. 9, No. 10, pp. 441–452.) The theory and method of representation developed by Bennett (see *Modulation Theory*, Black, 1953, p. 266) are applied to determine the spectra of pulse trains subjected to various types of modulation of practical importance.

621.39 : 621.376.5 **1204**

A Multichannel Pulse Communication System with Automatically Variable Number of Pulses.—R. Filipowsky. (*Öst. Z. Telegr. Teleph. Funk Fernsehtech.*, Sept./Oct. & Nov./Dec. 1955, Vol. 9, Nos. 9/10 & 11/12, pp. 113–129 & 147–158.) The operation of a p.c.m. system with asynchronous sampling is discussed in detail. In this system sampling is performed on the statistical basis of the amount of information in the different channels; this leads to improved use of overall channel capacity. Circuits for selecting the information-carrying channels are described. See also 562 of February.

621.39 : 621.376.5 : 621.396.822 **1205**

Noise Characteristics of Pulse-Slope-Modulation.—J. Das. (*Electronic Engng*, Jan. 1956, Vol. 28, No. 335, pp. 16–21.) The calculated signal/noise ratio at the output of a p.s.m. audio amplifier is 27·4 dB for an input peak ratio of 6 dB with random noise only. This is confirmed experimentally. The ratio improves with increased bandwidth and for a signal containing impulse noise.

621.39.018.756 **1206**

A Type of Signal Practically Limited in Time and in Frequency.—J. A. Ville & J. Bouzitat. (*Câbles & Transm.*, Oct. 1955, Vol. 9, No. 4, pp. 293–303.) The incompatibility of perfectly limited spectrum and finite duration in pulses is demonstrated; an expression is given for the spectrum of a finite-duration signal which can be considered limited for practical purposes. If as an approximation the spectrum of a nonlimited signal is represented by Shannon's series, the error introduced can be considered as a modulation; any signal can thus be represented as a sequence of modulated signals. This method is applied to various signal types, particularly the raised-cosine signal; the limited-spectrum signal is represented by a succession of raised-cosine signals.

621.396 : 621.376.5 **1207**

Pulse Multiplex Radiotelephone System in Greece.—J. J. Muller. (*Onde élect.*, Aug./Sept. 1955, Vol. 35, Nos. 341/342, pp. 711–713.) An account of the network covering nearly 2 000 km, which was put into service in 1954. There are 34 stations, with separations ranging from 14 to 120 km, at altitudes ranging from 20 to 1 800 m. Some of the links handle telegraphy and radio-program transmission as well as telephony. Fading effects are reduced by using diversity reception. Carrier frequencies are between 1·7 and 2·3 kMc/s. Particular aspects of the system are dealt with in the following separate papers:

High-Quality Radio Links over Sea Paths in Greece.—R. Cabessa (pp. 714–727).

Synchronization of the Greek Radio-Link System.—G. X. Potier (pp. 728–732).

Operational Reliability of the Greek Radio-Link System.—R. Basard (pp. 733–738).

621.396.41 : 621.396.65 **1208**

A 4-Channel Carrier Telephone System for the Argentine V.H.F. Radio Links.—Y. Boers. (*Commun. News*, Oct. 1955, Vol. 16, No. 1, pp. 30–34.) Description of the Type-STR 128 system. Each channel has a width of 6 kc/s; the a.f. band used is 300 c/s–3·4 kc/s, while signalling is effected on 4·3 kc/s. The four bands are transmitted in the inverted position, so that the total modulation frequency range is transformed from 300 c/s –22·3 kc/s to 1·7–23·7 kc/s; this reduces the modulation frequency spectrum by $2\frac{1}{2}$ octaves, considerably reducing the risk of intermodulation distortion.

621.396.41 : 621.396.65 : 621.376.4 **1209**

V.H.F. Phase-Modulated Transmitter-Receiver for 4-Channel Telephony.—J. M. M. Veldstra. (*Commun. News*, Oct. 1955, Vol. 16, No. 1, pp. 22–29.) Account of Type-SFR 329 radio equipment for use in conjunction with the channelling equipment described by Boers (1208 above).

621.396.44 + 621.397.242 **1210**

Distribution Systems.—J. Kason. (*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 88–90.) A system for relaying sound and television broadcasts, picked up on a central receiving aerial, to small blocks of flats etc., is

described. Signals are distributed at transmitted frequencies through channel amplifiers; suitable filter networks incorporated in mixing and splitter units enable subscribers to receive any programme at will.

621.396.6 : 621.396.11 **1211**

Tests on Long-Range Decimetre-Wavelength Multiplex Links.—Goublin. (See 1197.)

621.396.65.029.64 : 621.397.26 **1212**

New Microwave Repeater System using Traveling-Wave Tubes.—N. Sawazaki & T. Honma. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 19–24.) A system is described using travelling-wave valves as wide-band amplifiers in a reflex arrangement permitting the same valve to serve at r.f. and i.f. See also 2783 of 1954 (Nomura et al.).

621.396.712 : 621.396.65 **1213**

F.M. for B.F.N.—J. D. Parker. (*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 81–84.) The British Forces broadcasting network in Germany brought into service in 1956 constitutes a radio relay system in which the intermediate stations function as broadcasting stations, re-radiating the received program on different frequencies in the range 87·6–99·3 Mc/s. F.m. is used and the stations are automatically operated.

621.396.721 : 621.396.6 **1214**

Two-Metre Transmitter-Converter.—G. P. Anderson. (*Wireless World*, Feb. 1956, Vol. 62, No. 2, pp. 60–66.) A portable 6-W crystal-controlled transmitter working in the band 144–146 Mc/s and a receiver-converter are described for use with the equipment for 3·75 and 7·5 Mc/s of which details were given earlier (530 of 1954).

SUBSIDIARY APPARATUS

621-526 : 621.3.016.35 **1215**

Stability Criteria for an Electrical or Mechanical System with Distributed Parameters.—Gladwin. (See 992.)

621.311.62 : 621.314.5 **1216**

Advances in Vibratory-Power-Supply Techniques.—L. W. D. Sharp. (*Brit. Commun. Electronics*, Oct. 1955, Vol. 2, No. 10, pp. 54–58.) A brief review of British commercial vibrators. A table of the comparative performance of three typical vibrator units is given.

621.314.63 : 546.289 **1217**

The EW54 Germanium Junction Rectifier.—R. D. Knott & J. I. Missen. (*G.E.C. J.*, Oct. 1955, Vol. 22, No. 4, pp. 197–208.) The junction is produced by alloying a controlled quantity of In with a Ge crystal about 6 mm square and 0·4 mm thick with resistivity about 10 Ω. cm. The manufacture, electrical characteristics, and methods of assessing the performance of the rectifier are described. Applications are grouped into (*a*) use with resistive load, (*b*) use with battery load, and (*c*) pulse and miscellaneous. By virtue of its high efficiency this rectifier can be used for high powers with comparatively simple cooling systems.

621.314.63 : 546.824-3 **1218**

High-Temperature Area-Type Titanium-Dioxide Rectifiers.—H. C. Gorton, T. S. Shilliday & F. K. Eggleston. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, pp. 904–907.) Modifications in the methods of production, including the deliberate introduction of impurities, have led to improvements over the performance reported previously [2755 of 1955 (Shilliday & Peet)] in respect of maximum operating temperature, reverse/forward resistance ratio, and reproducibility of characteristics. Satisfactory operation at temperatures above 250°C for hundreds of hours is reported.

621.352.32 **1219**

Behaviour of MnO_2 as Depolarizer [in Leclanché-type cells].—J. Brenet, A. Grund & A. M. Moussard. (*Rev. gén. Élect.*, Oct. 1955, Vol. 64, No. 10, pp. 513–516.)

621.355 : 621.316.722.1 **1220**

Low-Voltage Stabilization.—(*Wireless World*, Feb. 1956, Vol. 62, No. 2, p. 70.) A form of Ni-Cd secondary cell is described having applications to the cathode biasing of valves. It provides a stable voltage of about 1·5 V which is practically independent of the current passed. The impedance is $< 1\ \Omega$ and is independent of frequency.

TELEVISION AND PHOTOTELEGRAPHY

621.397.26 : 621.396.65.029.64 **1221**

New Microwave Repeater System using Traveling-Wave Tubes.—Sawazaki & Honma. (See 1212.)

621.397.335 **1222**

Television Transmission without Synchronization Levels.—H. J. Griese. (*Nachrichtentech. Z.*, Oct. 1955, Vol. 8, No. 10, pp. 552–555.) A system is described in which the picture brightness levels occupy the whole modulation range and synchronization depends on coincidence between a local pulse and a stepped pulse transmitted during the horizontal blanking interval. The principal advantages are the improved signal/noise ratio and the removal of difficulties connected with holding the various levels constant.

621.397.5 **1223**

Phonevision—an Effective Method for Subscription Television.—A. L. C. Webb & A. Ellett. (*Proc. Instn Radio Engrs, Aust.*, Oct. 1955, Vol. 16, No. 10, pp. 341–353.)

621.397.5 : 535.623 **1224**

Compatible Colour Television.—J. Haantjes & K. Teer. (*Wireless Engr*, Jan. & Feb. 1956, Vol. 33, Nos. 1 & 2, pp. 3–9 & 39–46.) A system is described using two distinct subcarriers for the red and blue signals; the bandwidth for the red signal is 2 Mc/s and that for the blue is 1 Mc/s, and both lie within the normal-width luminance band. At the receiver the colour signals are fed to separate demodulators which include appropriate band-pass filters, and an equivalent green signal is formed locally. Receivers for this system, in contrast to those for the N.T.S.C. system, do not require subcarrier generators or synchronization of the colour-signal detectors. Important aspects of the two systems are tabulated for comparison.

621.397.61 **1225**

A 16-mm Projector for Operation with a Television Film Chain on a Partial-Storage Basis.—E. C. Fritts. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1955, Vol. 64, No. 10, pp. 576–577.) Apparatus described previously (268 of 1954) was modified for use with vidicon tubes. A 2–3 system separates the pull-down by the required integral number of television fields while maintaining the usual $2\frac{1}{2}$: 1 ratio between television fields and motion-picture frames.

621.397.61 **1226**

The Development and Design of an Underwater Television Camera.—D. R. Coleman, D. Allanson & B. A. Horlock. (*J. Brit. Instn Radio Engrs*, Dec. 1955, Vol. 15, No. 12, pp. 625–636. Discussion, pp. 636–639.) The camera described uses an image orthicon operating at 625 lines 50 frames or 525 lines 60 frames. The mechanical design of the casing is discussed and the handling arrangements for both diver-controlled and deep-sea cameras are described. Problems of underwater illumination are examined and a new type of remotely focused lamp is mentioned.

621.397.611 : 778.5 **1227**

Critical Considerations on Optical Compensation by means of Rotating Prisms in Television Film Scanners.—H. Grabke. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 9/10, pp. 166–170.) A prism with at least 24 sides and a built-in glass corrector is necessary to obtain satisfactory pictures. The coupling between film and prism is discussed.

621.397.611.2 **1228**

The 'Scenioscope', a New Television Camera Tube.—P. Schagen. (*Tijdschr. ned. Radiogenoot.*, Sept. 1955, Vol. 20, No. 5, pp. 291–305. In English.) Description of a tube in which the target is of slightly conducting glass, permitting charge to pass from the signal plate to the scanned surface. Very good picture quality can be achieved with an illumination of a few hundred lux; recognizable though 'noisy' pictures have been obtained with illuminations as low as 15 lux. See also 3762 of 1955.

621.397.621.2 : 621.385.832 : 535.65 **1229**

Two Photoelectric Colorimeters for Television Picture Tubes.—R. S. Hunter. (*J. electrochem. Soc.*, Sept. 1955, Vol. 102, No. 9, pp. 512–517.) The instruments described are intended primarily for measurements on monochrome picture tubes. One uses a single photocell and three filters on a disk, the other uses three photocells each with appropriate filter.

621.397.7 **1230**

A New N.W.D.R. Television [outside-broadcast] **Transmission Van.**—H. Krause & H. Käding. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 9/10, pp. 174–183.) The van is about 11 m long and weighs about 14 tons and carries complete equipment for three image-orthicon channels and 12 microphone channels. A detailed illustrated description is given.

621.397.7 : 535.623 **1231**

Integration of Color Equipment in a Television Station.—P. B. Laeser. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1955, Vol. 64, No. 10, pp. 537–541.) Problems involved in the installation at WTMJ-TV, Milwaukee, are discussed.

621.397.7 : 535.623 **1232**

CBS Television Color Studio 72.—R. B. Monroe. (*J. Soc. Mot. Pict. Telev. Engrs*, Oct. 1955, Vol. 64, No. 10, pp. 542–549.) Illustrated description of an installation in a converted theatre in New York.

621.397.8 : 535.8 **1233**

Influence of the Optical System on the Television Picture.—F. Below & H. Grabke. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 9/10, pp. 171–173.) Results of preliminary measurements indicate that local variations of picture quality can be assessed with sufficient accuracy from observations of the reproduction of black-to-white steps.

621.397.8 : 621.396.822 **1234**

The Visibility of Noise in Television.—(*B.B.C. Engng Div. Monographs*, Oct. 1955, No. 3, pp. 1–22.) Comprises the following parts:—

Part 1—The Visibility of Noise over the Grey Scale.—R. D. A. Maurice (pp. 5–12).

Part 2—The Visibility of Noise as a Function of Frequency.—M. Gilbert (pp. 13–16).

Part 3—Photographic Records of the Effect of Random Noise on a Television Picture.—G. F. Newell & J. G. Spencer (pp. 17–22).

TRANSMISSION

621.396.61 : 621.385 : 621.316.9 **1235**

Gas Tubes protect High-Power Transmitters.—W. N. Parker & M. V. Hoover. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 144–147.) Fault-detection and protective devices for transmitter valves are described.

VALVES AND THERMIONICS

621.314.63 **1236**

On the Transient Behaviour of Semiconductor Rectifiers.—B. R. Gossick. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1356–1365.) Theory and practical details of a pulse method of determining the characteristics of a p-n junction rectifier are discussed. See also 887 of 1954.

621.314.63.002.2 : 546.289 **1237**

Manufacture of Germanium Power Diodes.—(*Elect. Commun.*, Sept. 1955, Vol. 32, No. 3, pp. 146–164.) Various stages in the production of diffused-junction diodes are illustrated by photographs.

621.314.632 : 546.289] + 621.316.825 **1238**

The Turnover Phenomenon in Thermistors and in Point-Contact Germanium Rectifiers.—Burgess. (See 994.)

621.314.7 **1239**

Transistor Characteristics for Circuit Designers.—S. Schwartz. (*Electronics*, Jan. 1956, Vol. 29, No. 1, pp. 161–174.) Comprehensive tables giving the characteristics and operating parameters of 218 types of transistor made in the United States.

621.314.7 **1240**

The Field Effect Transistor.—G. C. Dacey & I. M. Ross. (*Bell Syst. tech. J.*, Nov. 1955, Vol. 34, No. 6, pp. 1149–1189.) Theory presented previously (3445 of 1953) is recapitulated and extended. Considerations of the field dependence of cut-off frequency f and transconductance on the one hand, and power dissipation on the other, lead to the conclusion that the best operating point is the critical field E_c above which carrier mobility is proportional to $E^{-0.5}$. The performance for this case is discussed in detail and the results are summarized in design nomograms. f is found to be inversely proportional to the 'pinch-off' voltage, but the latter cannot reasonably be reduced below 0·5 V, corresponding to a maximum value of 1 kMc/s for f. The manufacture and performance of various types, operating with field values in some cases below E_c and in others above, are described. Transistors can be designed for high-power operation at low frequencies and can be used to replace pentodes.

621.314.7 **1241**

Gain of Amplifying Transistors.—R. Monelli. (*Alta Frequenza*, Aug./Oct. 1955, Vol. 24, Nos. 4/5, pp. 356–374.) Equivalent circuits are presented for point-contact and junction transistors. Expressions are

derived for the gain, considering the transistor as an active quadripole. Values of gain and input resistance are tabulated for various commercially available transistors with various connections.

621.314.7 **1242**

Accelerated Power Aging with Lithium-Doped Point-Contact Transistors.—L. E. Miller & J. H. Forster. (*Trans. Inst. Radio Engrs*, July 1955, Vol. ED-2, No. 3, pp. 4–6.) Use of lithium-doped collector points facilitates observation of changes in transistor parameters during artificial aging tests; changes in the effective donor concentration in the formed region are responsible for the enhanced effects. The results indicate that changes associated with aging are not entirely due to changes in surface conduction.

621.314.7 **1243**

Negative-Resistance Regions in the Collector Characteristics of the Point-Contact Transistor.—L. E. Miller. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 65–72.) Anomalies of three different types have been observed in the V/I characteristics of various transistors. Typical curves are shown and the mechanisms responsible for the anomalies are discussed; the observed negative resistance is a property of the transistor itself and is attributable to a variation in the collection efficiency of the reverse-biased collector contact.

621.314.7 **1244**

The Dependence of Transistor Parameters on the Distribution of Base Layer Resistivity.—J. L. Moll & I. M. Ross. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 72–78.) Expressions are derived for the emitter efficiency, the transverse sheet resistance, the transit time and the cut-off frequency for uniform, linear, exponential and complementary-error-function distributions of impurities in the base of a junction transistor. For equivalent parameters the nonuniform distributions permit the use of wider base layers, but require greater maximum impurity concentrations and higher current densities.

621.314.7 : 537.531.9 **1245**

Dependence of Barrier-Layer Photoeffect on X Radiation.—J. Braunbeck & J. Zakovsky. (*Naturwissenschaften*, Nov. 1955, Vol. 42, No. 22, pp. 602–603.) Experiments on commercial junction transistors exposed to X rays are briefly reported; results are given for the Type-OC70 as typical. Curves show the variation of emitter and collector current (*a*) with wavelength and angle of irradiation and (*b*) with temperature.

621.314.7 : 621.396.822 **1246**

Shot Noise in *p-n-p* Transistors.—G. H. Hanson. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1388–1389.) Measurements on several types of transistor at frequencies up to 800 kc/s are reported. The frequency dependence of noise at high frequencies is in accordance with a formula derived by van der Ziel (600 of February).

621.38 : 001.4 **1247**

Russian Vacuum-Tube Terminology.—G. F. Schultz. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, p. 112.) A short list of basic terms is given together with the English translations.

621.383.4 : 621.396.822 **1248**

Reduction of Noise in Photoconductive Cells.—R. E. Burgess. (*Brit. J. appl. Phys.*, Nov. 1955, Vol. 6, No. 11, pp. 385–387.) "The factors determining the signal/noise ratio of photoconductive cells are briefly discussed and attention is drawn to the importance of the noise generated at the electrode contacts when current is flowing through the cell. Means are described for reducing or eliminating this component of noise by means of potential probes near the electrodes combined with suitable external circuits."

621.385 + 621.314.7 + 621.318.57 **1249**

Design of Electronic Devices for Production.—J. Thomson. (*Nature, Lond.*, 3rd Dec. 1955, Vol. 176, No. 4492, pp. 1059–1060.) Report of a summer school held at the Services Electronics Research Laboratories in September 1955. Various aspects of valve design were discussed, with emphasis on u.h.f. types; transistors and magnetic switching devices were also discussed.

621.385.029.6 **1250**

Thermal Motion of Electrons in a Two-Beam Amplifier.—M. I. Rodak. (*Zh. tekh. Fiz.*, April 1955, Vol. 25, No. 4, pp. 644–648.) The theory of a two-beam electron-wave valve is further developed by taking into account the effect of the thermal motion of electrons on amplification. The electron velocity distribution function is assumed to be Maxwellian. It is shown that this velocity distribution decreases the frequency range and the amplification. A sufficiently large velocity range makes amplification impossible.

621.385.029.6 **1251**

A Developmental Wide-Band, 100-Watt, 20-dB, S-Band Traveling-Wave Amplifier utilizing Periodic Permanent Magnets.—W. W. Siekanowicz & F. Sterzer. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 55–61.) Details are given of design, construction and performance. A permanent-magnet focusing system weighing only 2·8 lb has been developed.

621.385.029.6 **1252**

Transverse-Field Traveling-Wave Tubes with Periodic Electrostatic Focusing.—R. Adler, O. M. Kromhout & P. A. Clavier. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 82–89.) Valves are described in which the wave-propagating structure constitutes a smooth balanced transmission line for r.f. signals and serves at the same time as a space-periodic focusing field. Experimental structures for the 500–900-Mc/s band give wave-propagation velocities 1%–2% that of light, with characteristic impedances of about 500 Ω. Analysis based on transverse electron waves indicates that in order to obtain gain the electron stream must travel faster than the circuit wave by a substantial margin; gain is proportional to the square root of beam current. Experimental results are in good agreement with prediction from theory; noise figures as low as 6 dB have been obtained.

621.385.029.6 **1253**

Coupled Helices for Use in Traveling-Wave Tubes.—G. Wade & N. Rynn. (*Trans. Inst. Radio Engrs*, July 1955, Vol. ED-2, No. 3, pp. 15–24.) Theory is presented for propagation along coaxial helices in the presence of an axial electron beam. Curves show the propagation constants as functions of coupling coefficient and beam velocity, the helix voltages as functions of the physical dimensions, and a parameter related to the frequency response for different input and output couplers. The optimum length for coupling between the helices is greater in the presence of the beam, and the frequency for maximum transmission is lower. Preliminary work on a coupled-helix attenuator is mentioned.

621.385.029.6 : 621.318.2 **1254**

Permanent Magnets for Microwave Electron Valves.—M. de Bennetot. (*Onde élect.*, Aug./Sept. 1955, Vol. 35, Nos. 341/342, pp. 747–763.) Magnets are considered both for simple focusing, as in travelling-wave valves and multicavity klystrons, and for crossed-field systems, as in magnetrons. 'Tubular' constructions are discussed for which the main flux is from regions other than the pole pieces; uniformity of magnet composition is particularly important in such cases. Weights of focusing magnets range from 1·5 to 4·5 kg. See also 2991 of 1954.

621.385.029.6 : 621.374.4 **1255**

Multi-beam Velocity-Type Frequency Multiplier.—Y. Matsuo. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 101–106.) Experiments on a klystron with two nearly parallel beams are described; owing to the reduction of mutual-electron-repulsion effects, much higher output is obtainable than with a single-beam klystron. The device is expected to be useful as a mm-λ generator.

621.385.029.6 : 621.396.822 **1256**

Spurious Modulation of Electron Beams.—C. C. Cutler. (*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 61–64.) Noise at frequencies up to about 5 Mc/s in valves with high-intensity beams is found to be due to positive ions and secondary electrons. Oscillograms of various types of resulting modulation are shown. The effects are eliminated by improving the outgassing and evacuating and if necessary by deflecting the secondary electrons out of the beam.

621.385.032.2 **1257**

A Design of Triode Electron Gun.—K. C. Ho. (*Trans. Inst. Radio Engrs*, July 1955, Vol. ED-2, No. 3, pp. 10–14.) Analysis is given for a gun with two successive apertured-disk anodes, for producing a pencil beam. Focusing details for a 50-μA and 250-μA beam are treated as examples.

621.385.032.216 **1258**

New Type of Diffusion Cathode.—A. H. Beck, A. D. Brisbane, A. B. Cutting & G. King. (*Elect. Commun.*, Sept. 1955, Vol. 32, No. 3, pp. 172–178.) Reprinted from *Le Vide*, Nov. 1954, Vol. 9, No. 54, pp. 302–309. See also 1841 of 1955.

621.385.032.216 **1259**

Theoretical Basis for measuring the Saturation Emission of Highly Emitting Cathodes under Space-Charge-Limited Conditions.—C. R. Crowell. (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1353–1356.) Analysis is presented confirming that the current at the inflection point of the I/V characteristic of a diode gives a sensitive indication of the saturation emission of an oxide cathode. See also 2787 of 1955 (Hopkins & Shrivastava).

621.385.032.216 **1260**

Measurements of Retarding Potential on the Hollow Cathode.—A. W. Bright & J. S. Thorp. (*Nature, Lond.*, 3rd Dec. 1955, Vol. 176, No. 4492, pp. 1079–1080.) I/V characteristics of diodes with two different types of hollow cathode are compared with characteristics of planar diodes. The results appear to indicate that the electron temperature for the hollow cathode does not differ greatly from that for a normal oxide cathode at the same cathode temperature, thus supporting the hypothesis that the greater part of the emission comes from a region near the edge of the hole.

621.385.032.216 : 537.583 **1261**

Schottky Effect for SrO Films on Molybdenum.—G. A. Haas & E. A. Coomes. (*Phys. Rev.*, 15th Oct. 1955, Vol. 100, No. 2, pp. 640–641.) Thermionic-emission measurements on Mo filaments with very thin films of SrO are discussed briefly in relation to the theory of the surface potential barrier.

621.385.832 : 681.142 **1262**

Digital Memory in Barrier-Grid Storage Tubes.—M. E. Hines, M. Chruney & J. A. McCarthy. (*Bell Syst. tech. J.*, Nov. 1955, Vol. 34, No. 6, pp. 1241–1264.) A description is given of the operation of a c.r. tube in which the same beam is used for writing and reading signals in the form of charges on a dielectric plate held between the barrier grid and a backplate; storage capacity and probability of error due to amplifier noise are particularly discussed. Experimental tubes have been produced with a capacity of 16 000 information bits, with reading and writing times of about 1 μs.

621.387 **1263**

Glow-Discharge Tubes.—F. A. Benson & L. J. Bental. (*Wireless Engr*, Feb. 1956, Vol. 33, No. 2, pp. 33–38.) Continuing the investigation reported previously [3422 of 1954 (Benson & Mayo)], an examination has been made of the influence of cathode material, gas filling, gas pressure and geometrical dimensions on the magnitude and duration of the initial drift and on the running-voltage/temperature characteristics; specially made tubes were used. Results are shown graphically; they indicate that gas pressure and tube dimensions have little influence, while the cathode material and the nature of the gas filling do affect the characteristic.

621.387 **1264**

Improving Gas-Diode Voltage Characteristics.—(*Tele-Tech & Electronic Ind.*, Oct. 1955, Vol. 14, No. 10, pp. 67, 123.) Note on a method developed at the National Bureau of Standards. By applying a pulsed voltage through a common resistor to a large number of cold-cathode gas diodes connected in parallel the individual operating characteristics are rapidly equalized and stabilized.

621.387 : 621.318.57 **1265**

Traveling-Glow-Discharge Counter Tube.—E. W. Cowan. (*Rev. sci. Instrum.*, Oct. 1955, Vol. 26, No. 10, pp. 988–989.) Brief description of a tube using wire electrodes of special curved form.

MISCELLANEOUS

016.3 : 621.3 **1266**

Index to Convention Record of the I.R.E., Vol. 3, 1955.—(*Proc. Inst. Radio Engrs*, Jan. 1956, Vol. 44, No. 1, pp. 149 et seq.)

621.37/.39(083.74) **1267**

Standard Functional Divisions for Electronic Equipment.—R. S. Shultz & W. R. Waltz. (*Elect. Engng, N.Y.*, Oct. 1955, Vol. 74, No. 10, pp. 896–900.) Preliminary report of a survey of existing U.S. Navy electronic equipment undertaken with a view to further standardization. Edge-punched cards used in the analysis are shown.

621.3 **1268**

Radio and Television Engineers' Reference Book. [Book Review]—E. Molloy & W. E. Pannett. Publishers: Newnes, 1600 pp., 70s. (*J. Instn elect. Engrs*, Nov. 1955, Vol. 1, No. 11, pp. 717–718.) "... well worthy of a place in the library of every radio engineer."

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.014.5 + 538.56.029.1 **1269**

Subharmonic Oscillations in a Nonlinear System with Positive Damping.—S. Lundquist. (*Quart. appl. Math.*, Oct. 1955, Vol. 13, No. 3, pp. 305–310.)

534.121.2 **1270**

Study of the Thin Layer of Air between a Circular Diaphragm and a Plane Electrode.—C. Colin. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 863–873.) An experimental investigation was made using an electromechanical system with the diaphragm arranged between two symmetrically placed electrodes. The frequency variation of the transfer function of the equivalent quadripole network is analysed; a complex frequency is introduced.

534.13 **1271**

On Axi-symmetrical Vibrations of Shallow Spherical Shells.—E. Reissner. (*Quart. appl. Math.*, Oct. 1955, Vol. 13, No. 3, pp. 279–290.)

534.2 **1272**

Do Sound Waves possess Momentum?—W. Brenig. (*Z. Phys.*, 18th Nov. 1955, Vol. 143, No. 2, pp. 168–172.) Theory based on interaction with material indicates that sound waves have a momentum $p = \epsilon/c$, where ϵ is the energy and c the velocity of sound.

534.2 **1273**

Reflection and Transmission of Sound by a Moving Medium.—J. B. Keller. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1044–1047.) Analysis shows that the reflection and transmission coefficients depend only on that component of the velocity of the medium which lies in the plane of incidence. Total reflection occurs over a range of values of this velocity.

534.2 **1274**

Propagation of Sound in Thin Elastic Shells.—J. E. Young. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1061–1064.) Analysis leads to an expression for the axial propagation constant for a steel shell surrounding a column of air; only the lowest symmetric mode is discussed.

534.2 **1275**

Phase Velocities and Displacement Characteristics of Free Waves in a Thin Cylindrical Shell.—P. W. Smith, Jr. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1065–1072.) Analysis is presented covering all possible modes of propagation of elastic waves in the shell. Standing, axially progressive, and helically progressive waves are identified.

534.2-14 **1276**

Notes on the Exact Equations governing the Propagation of Sound in Fluids.—F. V. Hunt. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1019–1039.)

534.2-14 **1277**

Fluctuations in Intensity of Short Pulses of 14·5-kc/s Sound received from a Source in the Sea.—F. H. Sagar. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1092–1106.) Report of an extensive experimental investigation carried out off the coast of New Zealand, in which resolution of pulses arriving by direct and indirect paths was achieved. The pulse duration was 1·3 ms and the transmission range was 70–500 yd. The observed fluctuation, expressed as a 'variation coefficient' was 6·8%–10·6% for sea state 0 and 10·1%–12·5% for sea state 3.

534.2-8-14 **1278**

Swelling of a Liquid Surface under the Influence of Ultrasonic Radiation.—M. Kornfel'd & N. Molokhova. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1955, Vol. 105, No. 3, pp. 476–477. In Russian.) The experimentally determined relation between the ultrasonic energy density E, surface tension σ, the rise h of the liquid level, and the radius r of the swelling (equal to the radius of the quartz transducer) is given by $E = 2\sigma h/r^2$.

534.213.4 **1279**

Heat Conduction Losses in the Acoustic Boundary Layer.—J. E. Young. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1039–1043.) "The attenuation

resulting from heat conduction of the quasi-plane mode in a cylindrical conduit is discussed in the high-frequency (narrow boundary layer) limit. The heat conduction part of the Kirchhoff losses is derived by means of a volume integral whose physical interpretation can be given."

534.232 **1280**

On the Efficiency of an Acoustic Line Source with Progressive Phase Shift.—G. J. Thiessen. (*Canad. J. Phys.*, Nov. 1955, Vol. 33, No. 11, pp. 618–621.) Analysis indicates that the radiated energy is not reduced in consequence of a phase variation along a line source unless the rate of the variation is comparable to that in the propagated wave.

534.232 **1281**

Directional Properties of Continuous Plane Radiators with Bizonal Amplitude Shading.—G. E. Martin & J. S. Hickman. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1120–1127.) The problem of reducing the levels of the minor lobes of linear, rectangular, and circular radiators is considered theoretically. The shading is accomplished by using equiphase normal-velocity distributions limited to two discrete amplitudes. Linear and rectangular radiators with such amplitude distributions can be designed so that minor-lobe levels are at least 21 dB below the major-lobe level; the corresponding figure for the circular radiator is 25 dB. The results are useful for the design of transducers.

534.232-8 : 549.514.51 **1282**

The Resonance Enhancement of Ultrasonic Quartz Crystals.—G. Bolz. (*Z. angew. Phys.*, Nov. 1955, Vol. 7, No. 11, pp. 514–516.) The investigations described previously (2115 of 1950) are supplemented by measurements of the current generated by crystals of different thickness excited by an ultrasonic field of frequency constant at 2·04 Mc/s. Values of radiation resistance deduced from these measurements are in good agreement with values derived from the approximate formula presented previously.

534.3 + 621.395.623.7 **1283**

Fundamental Acoustics of Electronic Organ Tone Radiation.—D. W. Martin. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1113–1119.) The design of tone chambers and loudspeaker systems for electronic-organ installations in various types of auditorium are discussed.

534.6 **1284**

Measurement of Correlation Coefficients in Reverberant Sound Fields.—R. K. Cook, R. V. Waterhouse, R. D. Berendt, S. Edelman & M. C. Thompson, Jr. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1072–1077.) A cross-correlation coefficient R is used as a criterion of randomness in the sound field; in a completely random field, $R = (\sin kr)/kr$, where $k = 2\pi/\lambda$ and r is the distance between two points. An instrument for recording time variations of R is described and some measurements made in the 15 000-ft³ reverberation chamber at the National Bureau of Standards are reported.

534.614-14 **1285**

Fixed Path, Variable Frequency Acoustic Interferometer.—H. I. Leon. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1107–1112.) Equivalent-network analysis is presented for an interferometer comprising two crystals arranged parallel to one another, one serving as ultrasonic source and the other as fixed reflector. Measurements of the velocity of propagation in water over the frequency range 600–800 kc/s yield a value 1 496·8 ± 0·3 m/s at 25 °C, with a temperature coefficient + 2·7 m/s per °C.

534.64 : 621.3.012.11 **1286**

Circle Diagram for Acoustics.—B. Klimeš. (*Slab. Obz., Prague*, Oct. 1955, Vol. 16, No. 10, pp. P37–P42.) An acoustic-impedance calculator based on a modified Smith chart is described in detail. Examples are given illustrating the applications and the method of using the calculator which comprises a specially graduated ruler and a Smith chart plotted partly on a base sheet and partly on a superposed transparent sheet. Six parameters are used.

534.75 **1287**

Improvements in Message Reception resulting from 'sequencing' Competing Messages.—J. C. Webster & L. Sharpe. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1194–1198.)

534.75 **1288**

Effects of Response Complexity upon Listening to Competing Messages.—J. C. Webster & L. N. Solomon. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1199–1203.)

534.75 : 534.78 **1289**

Relative Intelligibility of Speech Recorded Simultaneously at the Ear and Mouth.—H. J. Oyer. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1207–1212.) "Monosyllabic words recorded at the lips and left ears of six speakers were fed to the headsets of 24 trained listeners at − 12, − 15, and − 18 S/N ratios. Although the trend for intelligibility scores throughout the test is in the same direction for signals of both origins, decreasing S/N ratio is more destructive to the speech picked up at the lips."

534.75 : 534.78 **1290**

Effects of Training on Listeners in Intelligibility Studies.—H. M. Moser & J. J. Dreher. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1213–1219.) Experimental evidence indicates that listener training has a great effect on the results in intelligibility studies.

534.781 : 621.376.5 **1291**

Laboratory Equipment for Quantizing Speech.—Allen. (See 1540.)

534.79 **1292**

Rating Scale Method for Comparative Loudness Measurements.—W. C. Michels & B. T. Doser. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1173–1180.)

534.84 **1293**

Study of Acoustical Requirements for Teaching Studios and Practice Rooms in Music School Buildings.—R. N. Lane & E. E. Mikeska. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1087–1091.)

534.845 : 677.64 **1294**

Acoustical Properties of Carpet.—C. M. Harris. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1077–1082.) Absorption measurements by the tube method were made on several hundred samples of

different types of carpet; flow-resistance was also measured. Absorption measurements on some of the samples were also made by the reverberation-chamber method; no simple relation is found between the results by the two different methods.

534.861 : 621.396.712 **1295**

Design of Studios for Small Broadcasting Stations.—R. F. Goodsman. (*J. Brit. Instn Radio Engrs*, Jan. 1956, Vol. 16, No. 1, pp. 5–28.) "Practical considerations in the siting, design and construction of studio buildings are given and methods of making studios and associated control rooms acoustically suitable are discussed. Reference is made to the studio building of the Trinidad Broadcasting Company, which incorporates one large, two medium, and two small studios. The equipment and circuit facilities provided in these studios and in the central control room are described."

621.395.616 : 534.61 : 621.3.089.6 **1296**

Probe Microphone Analysis and Testing at High Temperatures and High Intensities.—K. W. Goff & D. M. A. Mercer. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1133–1141.) Description of methods for testing a microphone system for measuring sound fields inside wind tunnels, etc.

621.395.623.64 + 534.833 **1297**

Design and Testing of Earmuffs.—J. Zwislocki. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1154–1163.) An estimate is made of the greatest attenuation that can be obtained without sacrificing comfort. The desirability of incorporating Helmholtz resonators in the design is discussed. Some subjective experiments of the sound attenuation produced by two different designs are described and the results analysed statistically.

621.395.623.743 **1298**

Design and Performance of a High-Frequency Electrostatic Speaker.—L. Bobb, R. B. Goldman & R. W. Roop. (*J. acoust. Soc. Amer.*, Nov. 1955, Vol. 27, No. 6, pp. 1128–1133.) The loudspeaker described has a diaphragm consisting of a thin polyester film covered with an evaporated gold layer, stretched around a semicylindrical ridged perforated electrode. The response varies $< \pm 2$ dB over the frequency range 8–16 kc/s.

AERIALS AND TRANSMISSION LINES

621.372.5.029.6 : 535.5 **1299**

Polarization Filters and Polarization Correctors.—G. Valensi. (*Ann. Télécommun.*, Nov. 1955, Vol. 10, No. 11, pp. 230–236.) Technique involving use of pleochroic crystals, familiar at optical frequencies, is adapted to the microwave region of the spectrum by using 'artificial crystals' comprising metal bodies regularly spaced in low-loss dielectrics. Results are reported of experiments with wire dipoles embedded in polystyrol plates arranged in a stack between radiating and receiving horns; reflection/frequency characteristics are plotted for different dipole orientations. Applications are briefly indicated.

621.372.8 **1300**

On Transients in Waveguides.—R. Gajewski. (*Bull. Acad. polon. Sci., Classe* 4, 1955, Vol. 3, No. 1, pp. 29–34. In English.) An analysis is made of the field variation during the interval between the arrival at a point in the waveguide of the forerunner and the main wave. The results are plotted as field-strength/time curves for a point 30 cm from the input of a waveguide with cut-off wavelength 6·28 cm and an applied signal of free-space wavelength 5 cm. During the interval examined, the 'frequency' changes rapidly, and a small but not negligible amount of energy is transferred.

621.372.8 **1301**

Diaphragms in Waveguides.—L. A. Vainshtein. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 841–846.) A rigorous mathematical analysis is presented of the conditions in a rectangular waveguide, half of the cross-section of which is occupied by an asymmetrical diaphragm (inductive or capacitive). The exact results so obtained are compared with previously published approximate data.

621.372.8 **1302**

On the Resonance Frequencies and the Field Configurations in Terminated Corrugated Waveguides.—V. J. Vanhuyse. (*Physica*, Oct. 1955, Vol. 21, No. 10, pp. 829–838.) Generalization of analysis presented previously (2836 of 1955).

621.372.8 : 621.372.54 **1303**

The Polarguide—a Constant-Resistance Waveguide Filter.—Klopfenstein & Epstein. (See 1330.)

621.396.67.029.53 **1304**

Standardised Transmitting Aerials for Medium-Frequency Broadcasting.—S. F. Brownless. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1955, Vol. 16, No. 11, pp. 383–396.) "The [Australian] Postmaster-General's Department has developed a range of aerial systems suitable for National Broadcasting Service transmitting stations of powers from 200 watts to 50 kilowatts in the frequency range 540–1 600 kc/s. The aerial systems fall into two classes: 'high' aerials having special anti-fading properties, usually near half-a-wavelength in height, and 'low' aerials less than a quarter-wavelength in height. This paper traces the development of the designs, with special emphasis on low aerial systems suitable for construction by Departmental staff. Here the application of practices well-established at v.h.f. leads to structures believed to be novel for m.f. broadcasting. Charts and diagrams are given from which aerial structures suitable for any particular application may be readily selected."

621.396.674.33 **1305**

Broadband Antenna for Field-Intensity Meters.—E. N. Singer & H. R. Caler. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 130–131.) Brief details are given of a skeleton biconical closed-end aerial which can be used without readjustment over a 1 : 4·5 frequency range, e.g. 88–400 Mc/s. The design of the associated balun is also described.

621.396.677 **1306**

Endfire Slot Antennas.—B. T. Stephenson & C. H. Walter. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 81–86.) Design theory is discussed. Discontinuities in the waveguide system are minimized by use of tapering sections and dielectric fillings; wide-band characteristics are obtained by means of wide-aperture slots. A flared slot aerial tested over the 3–6-cm band gave side lobes at least 20 dB down, with a radiation efficiency ranging from 65% at 3-cm λ

to 55% at 6-cm λ, the discontinuity minimizing device causing a 25% drop in efficiency; the voltage s.w.r. was < 1·4.

621.396.677.3.029.62 **1307**

Multiple Tuning in TV Antenna Design.—J. F. Guernsey. (*Radio and Telev. News*, Oct. 1955, Vol. 54, No. 4, pp. 91–92..94.) Use of the 'wing' dipole in a Yagi array gives good performance over bands I and III. A typical array using three wing dipoles has ten parasitic and nine active elements stagger-tuned to give flat response throughout the ranges.

621.396.677.32 **1308**

A Nonresonant Endfire Array for V.H.F. and U.H.F.—W. A. Cumming. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 52–58.) A development of the helical aerial [1860 of 1949 (Kraus)] using rectilinear elements and giving linear polarization is described. A balanced array has been constructed which provides a gain of 6–10 dB above a simple dipole over a 50% frequency range and gives a voltage s.w.r. ≯ 2·5 : 1 on a 300-Ω unscreened twin feeder.

621.396.677.71 **1309**

An Investigation of Slot Radiators in Rectangular Metal Plates.—D. G. Frood & J. R. Wait. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 103–109.) Measurements of the equatorial-plane radiation pattern of an axial λ/2 slot are compared with values calculated on the assumption that the plate can be represented by a thin elliptic cylinder or ribbon of infinite length. For a plate whose length is equal to or greater than its width the measured and calculated values agree to within a few per cent.

621.396.677.8 **1310**

Aerials with Reflectors and Conducting Disks for Decimetre Wavelengths.—G. von Trentini. (*Nachrichtentech. Z.*, Nov. 1955, Vol. 8, No. 11, pp. 569–577.) Dipole aerials combined with various arrangements of metal plates and strips are discussed. An arrangement relying on diffraction effects comprises a horizontal support carrying nine equally spaced parallel disks. Radiation patterns are calculated. The parallel-disk aerial has a higher gain than the reflector aerial of comparable dimensions, but the side-lobes are stronger; methods for overcoming this disadvantage are indicated.

AUTOMATIC COMPUTERS

681.142 **1311**

The Program-Controlled Electronic Computer at Munich (PERM).—H. Piloty, R. Piloty, H. O. Leilich & W. E. Proebster. (*Nachrichtentech. Z.*, Nov. & Dec. 1955, Vol. 8, Nos. 11 & 12, pp. 603–609 & 650–658.) Detailed illustrated description of a machine designed for calculations on scientific problems. A binary internal system is combined with a decimal external system. The word length is 50 binary digits. The magnetic-drum store rotates at 250 rev/sec; mean access time is 2 ms and capacity is 8 192 words. Teleprinter tape is used for input and output, with photoelectric scanning also for the input. 2 400 vaives and 3 000 Ge diodes are used; the power consumption is < 11 kW.

681.142 **1312**

An Accurate Electronic Multiplier.—S. Sternberg. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 618–634.) An account of developments of the time-division multiplier described by Goldberg (151 of 1953). A design giving long-term stability and increased speed of operation is described.

681.142 : 538.221 **1313**

Magnetic Core Circuits for Digital Data-Processing Systems.—D. Loev, W. Miehle, J. Paivinen & J. Wylen. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 154–162.) Circuits for interconnecting toroidal cores used to perform various functions in digital computers are discussed. A single-diode loop permits unconditional transfer of information from one or more transmitting cores to one or more receiving cores. A split-winding loop permits conditional transfer and hence logical operations. An inhibit loop is also described. The operation of shift registers, cycle distributors, counters, etc. is explained.

681.142 : 621.317.727 **1314**

A Digital Potentiometer.—S. K. Dean & D. F. Nettell. (*Electronic Engng*, Feb. 1956, Vol. 28, No. 336, pp. 66–69.) Description of an instrument developed for use with a teleprinter perforator for feeding measured voltage readings into an electronic computer. By comparing the input signal voltage with a series of reference voltages the former is represented in integers on a binary or decimal scale. Tests on a 10-stage instrument described indicate that a reliable 7-stage unit with a reading time under 3 sec can be constructed with readily available components.

681.142 : 621.37 **1315**

The Isograph—an Electronic Root Finder.—A. K. Choudhury. (*Indian J. Phys.*, Oct. 1955, Vol. 29, No. 10, pp. 468–473.) The instrument described is designed on the principle of harmonic synthesis, short-circuited and open-circuited delay lines fed from a matched frequency-sweep generator being used to produce the sine and cosine terms respectively. By controlling the amount of frequency sweep, any desired interval of the argument can be expanded and the accuracy of measurement thus increased.

681.142 : 621.383 **1316**

Character Recognition for Business Machines.—M. H. Glauberman. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 132–136.) Arabic numerals are scanned by a column of photocells whose outputs modulate a pulse-generator system to give signals usable in computers. Characters are read at a maximum rate of 1 600/sec; operation is not critically dependent on style or size of type.

681.142 : 413.164 **1317**

Glossary of Terms relating to Automatic Digital Computers, B.S.2641 : 1955. [Book Notice]—Publishers: British Standards Institution, London, 1955, 3s. (*Brit. Stand. Instn Inform. Sheet*, Nov. 1955, p. 2.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.3/.4 **1318**

Formulas for computing Capacitance and Inductance.—C. Snow. (*Nat. Bur. Stand. Circulars*, 10th Sept. 1954, No. 544, 69 pp.) A collection of explicit formulae in terms of elementary functions, Legendre polynomials and functions, and elliptic functions. Formulae for mutual inductance and for the forces acting between current-carrying coils are also given.

621.318.57 : 621.373.1 : 537.312.8 **1319**

New Active Circuit Element using the Magnetoresistive Effect.—A. Aharoni, E. H. Frei & G. Horowitz. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1411–1415.) A basic circuit is considered comprising a bridge with resistance arms lying in the uniform field produced by current through a coil in the bridge diagonal. Analysis indicates that bistable operation is possible with reasonably short resolving time; it may be necessary to operate at low temperature. A design is described using Bi layers in the gaps of U-shaped electromagnets. Tristable operation is possible but not practical.

621.319.4 : 621.315.615 **1320**

Chlorinated Diphenyl Capacitors: a Survey of Production Technique.—P. D. Wilmot. (*Elect. Rev., Lond.*, 28th Oct. 1955, Vol. 157, No. 18, pp. 838–840.) Advantages of chlorinated diphenyls over mineral oil as impregnants for paper include (*a*) higher dielectric strength, and (*b*) higher permittivity. Applications include use in power-factor-correction capacitors.

621.372.011.1 **1321**

Generalization of Variation and Compensation Theorems for *n* Parameters of an Electrical Circuit.—N. A. Brazma. (*C. R. Acad. Sci. U.R.S.S.*, 11th Nov. 1955, Vol. 105, No. 2, pp. 271–274. In Russian.) The effect of impedance variations in one or more branches of a network on the current in one of the branches is calculated using matrices.

621.372.412 **1322**

Thickness-Shear and Flexural Vibrations of Rectangular Crystal Plates.—R. D. Mindlin & H. Deresiewicz. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1435–1442.) Analysis is given for the infinite plate, the simply supported rectangular plate and the rectangular plate with one pair of parallel edges free and the other pair simply supported. For previous work see 1861 of 1951 and 2156 of 1952 (Mindlin).

621.372.412 : 549.514.51 **1323**

The Temperature Variation of the Frequency of AT- and BT-Cut Quartz Resonators.—R. Bechmann. (*Arch. elekt. Übertragung*, Nov. 1955, Vol. 9, No. 11, pp. 513–518.) Measured frequency/temperature characteristics can be represented analytically as power series, three terms being sufficient to deal with the temperature range $-60°$ to $+100°C$. The influence of the order of overtone on the temperature coefficient is discussed. See also 346 of February.

621.372.413.011.2 **1324**

Calculation of Shunt Resistances of Rhumbatron-Type Cavities.—W. Chahid. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1733–1736.) The calculation is facilitated by deriving the expression for the shunt resistance in a form in which the axial electric field strength is the only independent variable.

621.372.414 : 621.372.8 **1325**

Traveling-Wave Resonator.—P. J. Sferrazza. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section 1, pp. 84–85..143.) A circuit comprising a directional coupler with the secondary arm ports connected to form a continuous loop is used for storing energy extracted from the primary in a wave which circulates around the loop. An X-band version used in testing for high-power breakdown is briefly described. Presented at the 1955 National Electronics Conference.

621.372.5 : 512.831 **1326**

An Expression for the Powers of a Matrix and its Application to Iterated Networks.—A. Fekhikher. (*Ann. Télécommun.*, Nov. 1955, Vol. 10, No. 11, pp. 237–241.)

621.372.5 : 621.3.018.75 **1327**

Optimum Characteristics of Linear Pulse Systems.—R. Kulikowski & J. Plebański. (*Bull. Acad. polon. Sci., Classe* 4, 1955, Vol. 3, No. 1, pp. 23–28. In English.) General analysis is presented establishing the conditions for minimum distortion of pulses in linear systems. The analysis is applied to particular filter circuits. The results are embodied in three theorems.

621.372.54 **1328**

A General Theory of Reactive Non-dissipative L-Sections.—A. Mogensen. (*Kungl. tek. Högsk. Handl., Stockholm*, 1955, No. 95, 60 pp. In English.) Elementary theory is developed based on Foster's reactance theorem.

621.372.54 **1329**

The Design of Filters using only *RC* Sections and Gain Stages.—A. N. Thiele. (*Electronic Engng*, Jan. & Feb. 1956, Vol. 28, Nos. 335 & 336, pp. 31–36 & 80–82.) "A method is described of synthesizing filters, using *RC* sections within a feedback loop. Design information is given for high- and low-pass filters of 12, 18 and 24 dB per octave slope and fixed cut-off frequency, and others of approximately 12 and 18 dB per octave slope, whose cut-off frequency is variable continuously by the adjustment of a single element."

621.372.54 : 621.372.8 **1330**

The Polarguide—a Constant-Resistance Waveguide Filter.—R. W. Klopfenstein & J. Epstein. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 210–218.) The filter described comprises a circular waveguide with spaced radial-line cavities by means of which a linearly polarized input wave is converted to a circularly polarized wave [see 25 of 1955 (Klopfenstein)] and subsequently re-converted. The device can handle high powers; a design for a television vestigial-sideband filter is described.

621.372.54 : 621.39.001.11 **1331**

Statistical Design and Evaluation of Filters for the Restoration of Sampled Data.—R. M. Stewart. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 253–257.)

621.372.54.029.62 : 621.372.2 **1332**

'T'-Stub Calculation for V.H.F. Transmission Line Filters.—M. Telford. (*Marconi Rev.*, 4th Quarter 1955, Vol. 18, No. 119, pp. 121–131.) A method is presented which has advantages over earlier methods in respect of flexibility and ease of calculation. It is applicable whether the stubs in a filter are true reciprocals or not and also in cases where another element, such as an isolating stub, is combined with a 'T' stub to give a required frequency response.

621.373.42.029.42 **1333**

An Oscillator for Very Low Frequencies.—(*Radio elect. Rev., Wellington, N.Z.*, 1st Oct. 1955, Vol. 10, No. 8, pp. 31–32.) A circuit giving sinusoidal oscillations with periods of 35 sec or more uses cathode-follower connected triodes as phase-shift elements.

621.373.52 : 621.314.7 **1334**

Frequency Stability of Point-Contact Transistor Oscillators.—C. C. Cheng. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 219–223.) The duality relation between circuits using the voltage-controlled negative-impedance base-input characteristic and those using the current-controlled negative-impedance emitter-input or collector-input characteristic is demonstrated. Stabilization criteria for both cases are derived analytically and are confirmed experimentally.

621.373.52.029.3 **1335**

A Frequency-Stable Transistor Audio Oscillator of Very Simple Design.—W. D. Edwards. (*Canad. J. Technol.*, Nov. 1955, Vol. 33, No. 6, pp. 413–420.) A circuit is described in which a point-contact transistor maintains oscillations by supplying current pulses to a series *LC* circuit during half-cycle periods when the emitter is conducting. Frequency stability is improved by including a diode in the emitter circuit.

621.374.3 : 621.318.57 **1336**

High Sensitivity and Accuracy Pulse Trigger Circuit.—S. Barabaschi, C. Cottini & E. Gatti. (*Nuovo Cim.*, 1st Nov. 1955, Vol. 2, No. 5, pp. 1042–1051. In English.) A pulse-height discriminator is described which incorporates a highly stable differential negative resistance provided by a Type-6CS6 multi-electrode valve, by virtue of current division between screen grid and anode. This circuit is compared with that of Kandiah (3486 of 1954), in which the negative resistance is provided by a cathode-coupled pair of valves. The discriminator threshold can be set in the range 1–30 mV with stability within 1%.

621.374.32 : 621.318.57 : 621.387.032.212 **1337**

Subtracting Counter using Dekatron Tubes.—A. Coche. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 861–863.)

621.375 : 621.372.57 **1338**

Active Quadripoles with Intermediate-Point Earthing.—H. Beneking. (*Arch. elekt. Übertragung*, Nov. 1955, Vol. 9, No. 11, pp. 519–527.) The discussion is based on a valve circuit described by Cantz (*Telefunken Röhre*, 1953, No. 30, p. 52) in which a point on a coil in the grid-cathode circuit is earthed. Generalized analysis is presented, using matrices. The treatment is suitable for any valve or transistor circuits that can be considered as series-parallel or parallel-series networks, and facilitates the development of some useful new circuits.

621.375.13 **1339**

Effect of Component Tolerances in Low-Frequency Selective Amplifiers—an Analysis.—N. S. Nagaraja. (*J. Indian Inst. Sci.*, Section B, Oct. 1955, Vol. 37, No. 4, pp. 324–337.) Amplifiers with Wien-bridge or twin-T selective feedback networks are considered. When the networks are designed for maximum selectivity, the Q factor of the amplifier is relatively sensitive to variation of network component values; this sensitivity can be reduced by suitable choice of component relative values, but a higher gain is then required to obtain the same selectivity.

621.375.2 **1340**

Amplifier Stage with Monotonically Rising Response to a Step Signal.—J. Roorda. (*Tijdschr. ned. Radiogenoot.*, Nov. 1955, Vol. 20, No. 6, pp. 353–377.) The problem is to combine the monotonic response with the shortest possible rise time. Starting from consideration of a simple *RC* coupling, and using analysis based on Laplace transforms, the coupling circuit giving the required response is found in the form of a Π network with parallel-*RC* vertical and series-*LR* horizontal arms.

621.375.2.024 **1341**

Valve Amplifiers for Very Low Frequencies.—W. Ruppel. (*Nachrichtentech. Z.*, Nov. 1955, Vol. 8, No. 11, pp. 595–602.) D.c. amplifier circuits are briefly reviewed and descriptions are given of a high-gain voltage amplifier using two triodes and a low-output-impedance current amplifier using four triodes in a push-pull arrangement.

621.375.221.2 : 621.385.15 **1342**

Distributed Amplifier using Tubes with Secondary Emission.—D. T. Jovanović & V. N. Kostić. (*Bull. Inst. Nuclear Sci. 'Boris Kidrich'*, March 1955, Vol. 5, pp. 23–27. In English.) Description of a two-stage amplifier with three Type-EFP60 valves in each stage, having a gain of 35 and a bandwidth of 160 Mc/s.

621.375.3 **1343**

Magnetic-Amplifier Design—a Practical Approach.—M. Lilienstein. (*Elect. Mfg.* March 1955, Vol. 55, No. 3, pp. 90–98.)

621.375.4 : 621.314.7 **1344**

Transistor Operating Conditions.—W. T. Cocking. (*Wireless World*, March 1956, Vol. 62, No. 3, pp. 109–111.) The use of the collector current/voltage characteristic curves in the design of earthed-base transistor amplifiers is discussed and numerical examples are given.

621.375.4 : 621.314.7 **1345**

Raising the Cut-Off Frequency of Transistors.—H. Rühl. (*Nachrichtentech. Z.*, Nov. 1955, Vol. 8, No. 11, pp. 593–594.) Results of experiments with *n-p-n* and *p-n-p* transistors support Herzog's calculations (42 of 1955) of the rise of cut-off frequency attainable by connecting a neutralizing inductance in parallel with the capacitance between collector and emitter.

621.375.4.029.3 : 621.314.7 **1346**

High-Gain Transistor Amplifier.—J. J. Davidson. (*Audio*, Oct. 1955, Vol. 39, No. 10, pp. 66..70.) The advantages of transistors over valves as low-level, high-gain, amplifiers with low noise properties are discussed and illustrated by a commercial application in a gramophone pre-amplifier, in which a single transistor stage takes the place of two or more valve stages.

621.375.43 **1347**

Broadband Transistor Feedback Amplifiers.—J. Almond & A. R. Boothroyd. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 93–101.) Negative-feedback amplifiers involving three cascaded common-emitter junction-transistor stages are discussed. With large feedback, stability conditions can be determined with sufficient accuracy by considering the forward and return paths of the feedback loop separately. The maximum feedback possible without instability depends on the frequency characteristic of the transistor current gain; this characteristic can be represented with adequate accuracy by a minimum-phase *RC* approximation. Amplifiers with overall gain of 33 dB and negative feedback of 30 dB are described in which stability is secured by means of phase-advancing networks in the return path.

621.372 **1348**

Théorie des Réseaux de Kirchhoff. Régime Sinusoïdal et Synthèse. [Book Review]—M. Bayard. Publishers: Éditions de la Revue d'Optique, Paris, 1954, 408 pp., Swiss Fr. 42.65. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Nov. 1955, Vol. 33, No. 11, p. 476.) A comprehensive work on the analysis and synthesis of linear networks, forming one of a series presented by the Centre National d'Études des Télécommunications.

GENERAL PHYSICS

530.1 **1349**

The General Statistical Problem in Physics and the Theory of Probability.—D. Bohm & W. Schützer. (*Nuovo Cim.*, 1955, Supplement to Vol. 2, No. 4, pp. 1004–1047. In English.) An extended discussion leads to the conclusion that the problems of statistical physics in which the theory of probability does not apply may be more important than those in which it does.

530.145 : 621.396.822 **1350**

Quantum Theory of Fluctuations.—H. Ekstein & N. Rostoker. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1023–1029.) On the basis of an analysis of method of measurement, an operator is constructed for the spectral density of a fluctuating variable; the classical dynamic variables are replaced by time-dependent Heisenberg operators. The theory is used to deduce Nyquist's law for a particular case, and to calculate the shot effect for free uncorrelated electrons.

530.152.15 **1351**

A General Approach to Hysteresis: Part 4—An Alternative Formulation of the Domain Model.—D. H. Everett. (*Trans. Faraday Soc.*, Nov. 1955, Vol. 51, No. 395, pp. 1551–1557.) A comparison is made of various methods of formal representation of hysteresis phenomena in terms of a domain model. A symmetrical treatment is developed permitting the equations to scanning curves within a hysteresis loop to be written in a simple form. Part 3: *ibid.*, 1954, Vol. 50, pp. 1077–1096.

535.22 **1352**

Improved Value of the Velocity of Light derived from a Band-Spectrum Method.—D. H. Rank, H. E. Bennett & J. M. Bennett. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, p. 993.) A more accurate result than that reported previously [2619 of 1954 (Rank et al.)] has been obtained by using a new interferometric technique. The new value is 299 791·9 ± 2·2 km/s.

535.43 **1353**

Theory of Scattering [of light] **by an Inhomogeneous Solid possessing Fluctuations in Density and Anisotropy.**—M. Goldstein & E. R. Michalik. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1450–1457.)

537/538].081 **1354**

Memorandum on Electrical and Magnetic Units.—O. Löbl. (*Bull. Soc. franç. Élect.*, Nov. 1955, Vol. 5, No. 59, pp. 804–808.) Digest of a paper presented to the Society. The various units systems in use are examined; disadvantages of the m.k.s. and c.g.s. systems are indicated. A new system is proposed, called the 'système paritaire de coefficients'; this is based on four fundamental units and retains the practical units such as the volt etc. together with unity values for the dielectric constant and permeability of vacuum.

537.311 **1355**

The Electron-Phonon Interaction, according to the Adiabatic Approximation.—J. M. Ziman. (*Proc. Camb. phil. Soc.*, Oct. 1955, Vol. 51, Part 4, pp. 707–712.)

537.312.62 **1356**

Superconductivity at Millimeter Wave Frequencies.—G. S. Blevins, W. Gordy & W. M. Fairbank. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1215–1216.) Preliminary results of experiments on Sn at frequencies between 77 and 150 kMc/s are reported; residual resistivity is observed at these frequencies.

537.5 : 621.387 **1357**

The Electron Affinity of Hydrogen in a Microwave Gas Discharge.—D. Walsh. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 444–448.) Experiments show that hydrogen in a microwave gas discharge is a much better electron captor than its calculated capture cross-section would indicate, giving de-ionization times in T-R switches comparable with those obtained with water vapour.

537.52 **1358**

Disappearance of Adsorbed Gases from Dielectric Surfaces under Electrodeless Discharge.—S. R. Mohanti (Mohanty). (*Nuovo Cim.*, 1st Nov. 1955, Vol. 2, No. 5, pp. 1107–1109. Addendum, *ibid.*, 1st Jan. 1956, Vol. 3, No. 1, pp. 219–220. In English.)

537.525.5 : 621.385.132 **1359**

Studies of Externally Heated Hot-Cathode Arcs: Part 4—The Low-Voltage Form of the Ball-of-Fire Mode (the Low-Voltage Arc).—E. O. Johnson. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 498–532.) Discussion in terms of a model based on the observation that the stream of electrons entering the ball plasma from the cathode plasma is scattered so completely that the electrons within the ball have a Maxwellian energy distribution. Theoretical predictions are compared with probe measurements. Part 3: 2591 of 1955 (Johnson & Webster).

537.533/.534 **1360**

Ionization and Desorption due to Strong Electric Fields.—F. Kirchner & H. Kirchner. (*Z. Naturf.*, May 1955, Vol. 10a, No. 5, pp. 394–400.) Experimental investigations of the intensity distribution of field-type electron emission from single-crystal W points covered with thin films of other material are reported. Where surface compounds of W with O or C are present, a characteristic change of the emission distribution is observed after application of an opposing field. The change is attributed to local ionization, an electron being released into the interior of the metal and a positive ion being emitted into the vacuum if the field is strong enough to overcome the image force. The field ionization of physically adsorbed molecules or atoms requires relatively strong fields. Quantitative estimates are made of the 'pull-off' field strength and its temperature variation.

537.533 **1361**

A Method for the Systematic Calculation of an Electron-Optically Effective Field Distribution with Specified Imaging Properties.—J. Picht. (*Optik, Stuttgart*, 1955, Vol. 12, No. 10, pp. 433–440.) Analysis is given for a purely magnetic field.

537.533 : 537.29 **1362**

High Field Electron Emission from Irregular Cathode Surfaces.—T. J. Lewis. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1405–1410.) The enhancement of the field in front of an emitter due to surface irregularities (2631 of 1954) is studied in detail, with reference to mechanisms proposed by Schottky and by Fowler & Nordheim. The enhancement factor varies with distance from the surface and is also field dependent. The results afford an explanation of anomalous conduction variations in liquids and gases.

537.533 : 621.385 **1363**

Space-Charge Effects in Electron Optical Systems.—K. T. Dolder & O. Klemperer. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1461–1471.) A discussion of spherical aberration in beams exhibiting a waist. Conditions for transition from waist to crossover are examined. Experimental results support the theory.

537.533.7 **1364**

Mean Free Path for Discrete Electron Energy Losses in Metallic Foils.—A. W. Blackstock, R. H. Ritchie & R. D. Birkhoff. (*Phys. Rev.*, 15th Nov. 1955, Vol. 10, No. 4, pp. 1078–1083.)

537.533.7 : 546.623-31 : 539.23 **1365**

Transmission of Electrons of Energies below 16 keV by Aluminium Oxide Films of Thickness 1 000 to 3 000 Å.—O. Hoffmann. (*Z. Phys.*, 18th Nov. 1955, Vol. 143, No. 2, pp. 147–152.)

537.56 : 537.311.37 **1366**

Critical Examination of the Theory of Plasmas based on Mean Free Path, in the Light of the Method based on the Distribution Function derived by solving Boltzmann's Equation.—R. Jancel & T. Kahan. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 824–828.) Discussion indicates that the distribution-function method is more suitable than the mean-free-path method for calculating the conductivity of anisotropic plasmas (e.g. plasmas subjected to electric and magnetic fields).

537.581 : 548.0 : 546.78 **1367**

Velocity Analysis of Thermionic Emission from Single-Crystal Tungsten.—G. F. Smith. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1115–1116.) It is suggested that the departure from a Maxwellian distribution observed by Hutson (3228 of 1955) is due to the finite resolution of the analyser.

538.114 **1368**

Spin-Deviation Theory of Ferromagnetism: Part I—General Theory.—J. Van Kranendonk. (*Physica*, Oct. 1955, Vol. 21, No. 10, pp. 749–766.)

538.114 **1369**

The Origin of Ferromagnetism in Transition Metals.—J. Friedel. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 829–838.) Analysis of experimental evidence indicates that the energy-band concept constitutes a more satisfactory basis for the theory of ferromagnetism than the hypothesis that the magnetic carriers are bound to individual atoms. The occurrence of fractional numbers of carriers is explained on the basis of close-range interactions between carriers associated with the same atom. The absence of ferromagnetism in heavy elements such as Pd and Pt is a consequence of strong spin-orbit coupling.

538.114 **1370**

Influence of Crystalline Electric Fields on Antiferromagnetic Transitions.—L. D. Roberts, R. B. Murray & J. W. T. Dabbs. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1100–1103.)

538.3 **1371**

On the Ampère Force.—P. Moon & D. E. Spencer. (*J. Franklin Inst.*, Oct. 1955, Vol. 260, No. 4, pp. 295–311.) A re-examination of the expressions for the Ampère force (2923 of 1954) taking account of Warburton's comments (1321 of 1955).

538.312 **1372**

Source Representations for Debye's Electromagnetic Potentials.—A. Nisbet. (*Physica*, Oct. 1955, Vol. 21, No. 10, pp. 799–802.) Theory of e.m. radiation presented by Bouwkamp & Casimir (413 of 1955) is discussed; Debye potentials can be used for all points, even within the source distribution. This leads to an alternative method for the direct determination of multipole expansions.

538.56 : 537.56 **1373**

Electrodynamics of Turbulent Ionized Media.—T. Kahan. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1726–1727.) The scattering of e.m. power in a turbulent ionized medium is discussed. To be applicable for arbitrary values of electron density, analysis should take account of multiple scattering. Suitably modified forms of Navier's equations are indicated.

538.56.029.1 + 534.014.5 **1374**

Subharmonic Oscillations in a Nonlinear System with Positive Damping.—S. Lundquist. (*Quart. appl. Math.*, Oct. 1955, Vol. 13, No. 3, pp. 305–310.)

538.566 **1375**

Theory of Total Reflection.—F. I. Fedorov. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1955, Vol. 105, No. 3, pp. 465–468. In Russian.) The theory of total reflection of an elliptically polarized plane wave is developed from expressions for the energy density and the Poynting vector, using the notation of the earlier paper (3239 of 1955). Results indicate that at total reflection the mean flow of energy in the refracted wave contains a component normal to the plane of incidence; this component is zero in non-total reflection and in two special cases; its magnitude is proportional to the wavelength in the first medium.

538.566 **1376**

Maximum Transmission of Electromagnetic Waves by a Pair of Wire Gratings.—G. von Trentini. (*J. opt. Soc. Amer.*, Oct. 1955, Vol. 45, No. 10, pp. 883–885.) An experimental investigation was made of the transmission of 3·2-cm-λ waves through a pair of parallel wire gratings with various wire and grating spacings for various angles of incidence. Results are compared with values derived from theory.

538.566 : 535.42] + 534.26 **1377**

Semi-asymptotic Series for the Diffraction of a Plane Wave by a Cylinder.—W. Franz & R. Galle. (*Z. Naturf.*, May 1955, Vol. 10a, No. 5, pp. 374–378.)

The technique described previously, involving Watson transforms [1955 of 1955 (Franz)] is used to develop series up to $(ka)^{-2}$, where $k = 2\pi/\lambda$ and a is the radius of the cylinder.

538.566 : 535.42 **1378**

Variational Formulation of Two-Dimensional Diffraction Problems with Application to Diffraction by a Slit.—A. T. de Hoop. (*Proc. kon. ned. Akad. Wetensch. B*, 1955, Vol. 58, No. 5, pp. 401–411. In English.) Diffraction particularly of e.m. waves is discussed. Analysis shows that for an incident plane wave the complex amplitude of the far-zone diffracted field can be expressed in a stationary form of the type indicated by Levine & Schwinger (83 of 1950). The case of a diffracting slit of infinite length and finite width is treated in detail. For normal incidence the results agree with those of Bouwkamp (2909 of 1954) and Müller & Westpfahl (1971 of 1953).

538.566 : 535.42 **1379**

On Integrals occurring in the Variational Formulation of Diffraction Problems.—A. T. de Hoop. (*Proc. kon. ned. Akad. Wetensch. B*, 1955, Vol. 58, No. 4, pp. 325–330. In English.)

538.566 : 535.42 **1380**

The Diffraction of Electromagnetic Waves at a Grating consisting of Parallel Conducting Strips.—L. A. Vainshtein. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 847–852.) A rigorous solution is given for diffraction of a normally incident plane e.m. wave, the width of the strips being equal to the spaces between them. Graphs show the reflection and transmission of the wave for various ratios of strip width to wavelength, and the amplitudes of the diffraction spectra.

538.566 : 535.42 : 621.372.8 **1381**

Diffraction of Centimetre Waves by a Conducting Sphere in a Waveguide.—W. Chambron. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 891–892.) Measurements were made at a frequency of 9·1 kMc/s using a hybrid-T arrangement. Results indicate that reflection coefficient is proportional to sphere volume; dispersion of results is attributed to small geometrical irregularities. The work is preliminary to a study of the diffraction of e.m. waves by clouds.

538.566 : 535.43 **1382**

Scattering of Electromagnetic Waves from a Random Surface.—W. C. Hoffman. (*Quart. appl. Math.*, Oct. 1955, Vol. 13, No. 3, pp. 291–304.) The medium below the surface is assumed to be perfectly conducting, so that the far-zone form of the Stratton-Chu solution can be used. The mean and covariance of the approximate expression for the scattered radiation are determined for both vertical and horizontal polarization.

538.566 : 537.562 **1383**

Interaction of Electromagnetic Waves of Radio-Frequency in Isothermal Plasmas: Collision Cross-Section of Helium Atoms and Ions for Electrons.—J. M. Anderson & L. Goldstein. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1037–1046.) Theoretical and practical aspects of the laboratory experiments described previously [2637 and 2970 of 1953 (Goldstein et al.)] are discussed and results of measurements using He gas are presented. The ratio of the effective cross-sections of ions and atoms for electron collisions is about 3×10^3 at an ion density of $10^{11}/cm^3$ at room temperature.

538.566 : 538.221 : 621.318.134 **1384**

Nonlinearity of Propagation in Ferrite Media.—A. Clavin. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol 44, No. 2, p. 259.) Measurements are briefly reported. Both losses and phase shift varied with temperature at constant power level. The results are compared with those of Sakiotis et al. (3240 of 1955).

538.566.2.029.6 : 537.226 **1385**

Investigations on Artificial Dielectrics at Microwave Frequencies: Part 1.—S. K. Chatterjee & B. V. Rao. (*J. Indian Inst. Sci.*, Section B, Oct. 1955, Vol. 37, No. 4, pp. 304–323.) The transmission of a H_{01} wave through a parallel-plate array was studied experimentally. The observed variation of phase change with angle of incidence is in fair agreement with that calculated from the formula given by Carlson & Heins (2756 and 3504 of 1947); the difference between them is attributed to diffraction effects and the presence of higher-order modes inside the array. Values are deduced for the minimum dimensions required to avoid diffraction effects.

538.569.4 **1386**

Resonance Transitions induced by Perturbations at Two or More Different Frequencies.—N. F. Ramsey. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1191–1194.) Expressions are derived for the alteration of magnetic resonance frequency due to the presence of a second oscillation at a nonresonance frequency. Applications of the formulae to nuclear-resonance and molecular-beam experiments are discussed.

538.569.4 : 535.33/.34 : 621.385.029.6 **1387**

Improvement in a Paramagnetic - Electron-Resonance Spectrograph. Application to the Study of Diphenylpicrylhydrazyl.—G. Berthet. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1730–1733.) The sensitivity of apparatus operating in the 3-cm band (*Onde élect.*, May 1955, Vol. 35, No. 338, pp. 489–490) is greatly increased when the klystron source of nominal power 30–40 mW is replaced by one of much higher power, e.g. 3 W.

538.569.4 : 535.34 **1388**

Relaxation Times in Magnetic Resonance.—D. Pines & C. P. Slichter. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1014–1020.) The effect of motion of the absorption centres on the width of resonance lines is discussed on the basis of a random-walk model, and a simple picture is presented of the electron relaxation processes.

538.569.4 : 535.34 **1389**

Some Devices for the Stark Modulation Millimeter-Wave Spectrograph.—A. Okaya. (*Rev. sci. Instrum.*, Nov. 1955, Vol. 26, No. 11, pp. 1024–1028.) An overall sensitivity of about $5 \times 10^{-8}\,cm^{-1}$ in the 6-mm wave range is attained as a result of appropriate design of Stark cell, frequency multiplier, lock-in detector and square-wave generator.

538.6 : 536.7 **1390**

Thermodynamical Theory of Galvanomagnetic and Thermomagnetic Phenomena.—R. Fieschi. (*Nuovo Cim.*, 1955, Supplement to Vol. 2, No. 4, pp. 1168–1170. In English.) Addendum to paper noted previously (1961 of 1955).

539.378.3 **1391**

The Optical Investigation of the Interdiffusion of Metals.—H. Schopper. (*Z. Phys.*, 8th Nov. 1955, Vol. 143, No. 1, pp. 93–117.) The technique used involves the preparation of very thin films of known thickness.

53.023 **1392**

Fundamental Formulas of Physics. [Book Review]—D. H. Menzel (Ed.). Publishers: Prentice-Hall, New York, 1955, 765 pp., $13.50. (*Science*, 18th Nov. 1955, Vol. 122, No. 3177, p. 976.) ". . . a valuable reference book for every physicist . . ."

538.569.4 : 535.33/.34 **1393**

Spectroscopy at Radio and Microwave Frequencies. [Book Review]—D. J. E. Ingram. Publishers: Butterworths Scientific Publications, London, 332 pp., 45s. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 457–458.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **1394**

The Identification of Radio Stars.—A. M. Naqvi & J. N. Tandon. (*Proc. nat. Inst. Sci. India*, Part A, 26th July 1955, Vol. 21, No. 4, pp. 244–251.) An examination is made of the possibility that the fainter radio stars, classified by Mills (333 of 1954) as Class II, are within our galaxy. The observed coincidences in position of radio stars and *M* dwarfs appear to be significant.

523.16 **1395**

Absorption of 3·5-m Radiation in the Optical Emission Nebula, NGC 6357.—B. Y. Mills, A. G. Little & K. V. Sheridan. (*Nature, Lond.*, 28th Jan. 1956, Vol. 177, No. 4500, p. 178.) This is the first reported case of absorption of radio waves by an emission nebula; it leads to an estimated electron temperature of 6 500°K for the nebula.

523.7 **1396**

East/West Asymmetry in the Formation of New Sunspots.—M. d'Azambuja. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1712–1714.) Analysis of records covering many years indicates that about twice as many centres of activity are observed on the eastern half of the solar disk as on the western half.

523.74 : 551.510.535 **1397**

A New Index of Solar Activity based on Ionospheric Measurements.—C. M. Minnis. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 310–321.) The monthly mean relative sunspot number R_M is assumed to contain a component constituting a direct index of solar activity R_v, together with an error component R_x having a standard deviation of about 20%. A new index I_{F_2}, based on an analysis of the critical frequency of the F_2 layer over the period 1938–1954, has been constructed whose residual error component is only one tenth that of R_x. The magnitude of I_{F_2} for a given month is computed from the mean noon F_2-layer critical frequencies at Slough, Huancayo and Watheroo and is based, in effect, on a calibration of the F_2-layer critical frequencies in terms of R_v.

523.75 **1398**

Accuracy of Solar-Flare Observations.—L. W. Ross. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 344–345.) The division of observed solar flares into more than three classes is not statistically justifiable; more uniform and detailed reporting is required.

523.75 : 550.385 **1399**

Solar H_α Filaments and Geomagnetic Disturbances.—H. I. Leighton & D. E. Billings. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 349–350.) Experiments to test Kiepenheuer's suggestion (3877 of 1947), identifying the solar *M*-regions causing geomagnetic disturbances with dark filaments on the solar disk, gave negative results.

523.78: 551.594.6 : 621.396.11 **1400**

The Influence of the Solar Eclipse on the Propagation of Atmospherics in the Frequency Range 5–30 kc/s.—G. Skeib. (*Veröff. met. hydrol. Dienst., Potsdam*, 1955, No. 16, pp. 24–27.) A map shows the position of sources of atmospherics in Europe at the time of the eclipse; records of measurements over a two-hour period show a marked eclipse effect on 30 kc/s with a 15-min delay, but little effect on 10 kc/s. An anomalous increase of field strength on 5 kc/s is related to the reduction of the ionosphere/earth-duct cut-off frequency resulting from the eclipse.

550.38 + 523.746 : 538.65 **1401**

The Stability of a Homopolar Dynamo.—E. Bullard. (*Proc. Camb. phil. Soc.*, Oct. 1955, Vol. 51, Part 4, pp. 744–760.) The stability of the self-exciting disk dynamo is considered, taking into account the friction at the axle and the effect of an external electrical load in parallel with the field coils. Possible analogies between the results obtained and the motion of an electrically conducting fluid in a magnetic field are discussed; the theory may be useful in explaining the magnetic field of the earth and of sunspots.

550.380.87 : 550.385 **1402**

A Method for the Elimination of Slow Variations in the Recording of Pulsations of the Geomagnetic Field.—P. A. Blum & A. Lebeau. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1807–1809.)

550.385 : 551.510.535 **1403**

The Diurnal Variation of Irregular Geomagnetic Fluctuations.—S. B. Nicholson & O. R. Wulf. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 389–394.) The diurnal variation of the fluctuations, showing a maximum in late evening for middle latitudes, is correlated with atmospheric turbulence in the ionosphere, which is assumed to be hindered in daytime by electromagnetic damping. There is also a pronounced seasonal effect; this may be connected with the large-scale circulation of the atmosphere.

551.51 **1404**

Thermal and Gravitational Excitation of Atmospheric Oscillations.—H. K. Sen & M. L. White. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 483–495.) Previous work is extended to include a unified treatment for both gravitational and thermal forcing functions. From consideration of various atmospheric models it appears that thermal effects are far more important than gravitational ones in producing the solar semi-diurnal pressure variation; this is not confirmed by observation, but the disagreement may be eliminated by assuming the possibility of heating other than by ground eddy currents.

551.510.53 **1405**

Nitrogen Oxides and the Airglow.—M. Nicolet. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 297–309.) Possible chemical and photochemical reactions which would account for the formation of nitrogen oxides in the upper atmosphere are discussed and are shown to provide a possible explanation of the airglow.

551.510.535 **1406**

On the Cooling of the Upper Atmosphere after Sunset.—A. N. Lowan. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 421–429.) Cooling in the E and F regions of the ionosphere is investigated theoretically,

assuming that heat transfer takes place only by conduction. At a time $2\frac{1}{2}$ h after sunset the temperature is unchanged at altitudes below 160 km; at a height of 380 km the maximum drop is 440°K. There should be an appreciable increase of ion density in the F layer, but this will be offset, except in equatorial regions, by downward diffusion.

551.510.535 **1407**

Formation of the Lower Ionosphere.—K. Watanabe, F. F. Marmo & J. Pressman. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 513–519.) The available evidence suggests that ions in the D layer are mainly produced by photo-ionization of NO; photo-ionization of O_2, at its first ionization potential, should occur in the E layer and further data are required to decide whether this layer is caused by such a process or by ionization by soft X rays.

551.510.535 **1408**

The Measurement of Normal E-Layer Critical Frequencies at Night.—W. R. Piggott. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 341–342.) The normal E-layer critical frequency at night is best determined from absorption/frequency curves, plotted as $-\log\rho/\log f$. Results of typical measurements taken with standard D.S.I.R. absorption measuring equipment (2301 of 1955) are shown. From the trend of f_0E variation it was possible to identify the associated absorption band on a few of the routine night-time $h'f$ curves obtained at Slough, in spite of the presence of E_s and other irregularities. From the variation of f_0E with time a recombination coefficient of about 10^{-8} was deduced, but, owing to the low transmitter power, measurements of $f_0E < 0{\cdot}7$ Mc/s could not be made; further work with higher power is needed.

551.510.535 **1409**

Night-Time Measurement of Positive and Negative Ion Composition to 120 km by Rocket-Borne Spectrometer.—C. Y. Johnson & J. P. Heppner. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, p. 533.) During a flight on 8th July 1955, only positive ions of mass number 28 were detected in the E region. These are identified as N_2^+. Ionospheric records for the same period and region show the existence of E_s clouds.

551.510.535 **1410**

Viscosity in the F Region.—J. W. Dungey & A. J. Willson. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 521–523.) It is shown that viscosity is of primary importance for disturbances whose scale is smaller than the mean free path λ, and cannot be described by an effective coefficient; any initial disturbance on such a small scale will disappear very rapidly. Assuming normally accepted values for λ at 400 km altitude, it follows that patches of ionization causing the twinkling of radio stars cannot be due to turbulence in the neutral gas as suggested by Maxwell (1649 of 1955).

551.510.535 **1411**

Changes in the Absorption of Cosmic Noise observed during Two Ionospheric Disturbances.—C. A. Shain. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 347–348.) Curves are given showing the observed time variation of total absorption at Hornsby (34° S, 151° E) and of f_0F_2 at Canberra (35° S, 149° E) and Brisbane (28° S, 153° E), at the period of ionospheric disturbances on 25th November 1950 and 20th August 1950. Following the suggestions of Mitra & Shain (1426 of 1954), increased absorption is shown to be correlated with increased f_0F_2 and is presumably due to F-region attenuation. Deductions are made as to the path and speed of the disturbances.

551.510.535 : 523.78 **1412**

Interpretation of Ionospheric Results during Eclipses.—J. Hunaerts & M. Nicolet. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 537–538.) Accounts published by various workers of the solar eclipse of 25th February 1952 have been analysed using the scale-height variation concept introduced by Nicolet (1644 of 1951). The vertical distribution of terrestrial atmospheric temperature varies with latitude, and the recombination coefficient in the E layer is $\leqslant 4 \times 10^{-8}$ cm³/sec.

551.510.535 : 551.594.5 **1413**

The Recombination Coefficient in the E-layer during Aurorae.—A. Omholt. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 345–346.) In an earlier paper (710 of 1955) a mechanism involving variations in positive-ion concentration was suggested to explain the abnormally high values of recombination coefficient during aurorae. An alternative explanation assuming a high value of the negative-ion/electron ratio (in the range 0·5–3) is shown to be in accordance with observed data.

551.510.535 : 621.317.799 **1414**

Variable-Frequency Echo Sounding of the Ionosphere at Oblique Incidence.—W. Dieminger, K. H. Geisweid & H. G. Möller. (*Nachrichtentech. Z.*, Nov. 1955, Vol. 8, No. 11, pp. 578–586.) The development of the technique described by Dieminger (674 of 1952) is discussed with particular attention to synchronizing arrangements. Records obtained over two paths are compared with records of vertical-incidence soundings at points on the paths.

551.510.535 : 621.396.11 **1415**

Heights of Irregularities giving Rise to the Fading of 150-kc/s Waves.—R. B. Banerji. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 431–439.) A calculation is made of the relation between phase and amplitude for a wave propagated through a region of random absorption below the reflection level; results agree with those obtained experimentally. A method for estimating particle collision frequency in the absorbing region is presented, based on that of Jones et al. (2311 of 1953), from which data regarding the region may be deduced.

551.510.535 : 621.396.11 **1416**

Polarization of Electromagnetic Waves for Vertical Propagation in the Ionosphere.—Roy & Verma. (See 1526.)

551.510.535 : 621.396.11 **1417**

Some Remarks concerning Ionospheric Absorption Work.—K. Rawer. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 534–535.) Irregularities in the frequency dependence of observed absorption decrements are attributed to focusing effects due to curvature of the layers involved. In the F layer these effects occur particularly with third-order echoes. Account should be taken of the effect in the analysis of absorption observations made during conditions of rapid fading.

551.510.535 : 621.396.812.3 **1418**

Ionospheric Wind Determination from Spaced Radio Receiver Fading Records.—G. W. G. Court. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp.

333–340.) Direct analysis of the fading patterns of reflected signals at three spaced receivers (96 of 1950 (Mitra)) can indicate the true ionospheric wind and changes in orientation of the patterns without assuming any particular distribution of orientation. A new method of analysis of the fading records is proposed, together with an alternative method of observation in which a single fixed receiver is used in conjunction with a second one which is moved in a circle round the first.

551.510.535"1955" : 621.396.11 **1419**

Ionosphere Review 1955.—T. W. Bennington. (*Wireless World*, March 1956, Vol. 62, No. 3, pp. 145–146.) Consideration of the records of sunspot numbers and ionosphere data indicates that solar activity may increase rapidly to reach a maximum in the middle of 1957, with the monthly mean daytime m.u.f. reaching 34 Mc/s for east-west transmissions and 38 Mc/s for southerly paths by November 1956.

551.594.5 **1420**

Vertical Extent of Auroral Arcs and Bands.—B. W. Currie & J. T. Weaver. (*Canad. J. Phys.*, Nov. 1955, Vol. 33, No. 11, pp. 611–617.) Measurements on 181 photographs taken from three stations indicate that quiet arcs and bands are confined to a narrow layer just about the 100-km level. The thickness of this layer is most often between 20 and 40 km, and rarely > 50 km. From the ratio of the number of arcs and bands to the total number of observed forms it is inferred that the percentage of auroral time during which the luminosity is restricted to this layer is 60%.

551.594.6 : 621.396.821 **1421**

The Effect of Atmospherics on Tuned Circuits.—Edwards. (See 1538.)

LOCATION AND AIDS TO NAVIGATION

621.396.93 **1422**

The Theoretical Design of Direction-Finding Systems for High Frequencies.—W. C. Bain. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 113–119.) "The problem of finding the bearing of a distant h.f. transmitter in conditions of wave interference is examined for the simplified case of non-interacting aerials on a plane earth and with no pick-up of horizontally polarized radiation. Two methods of approach are considered—solution of the field equations for a number of incident plane waves from a knowledge of the field at the aerials, and the fitting of rectilinear constant-phase lines to observed values by a 'least squares' process. It is shown that the cyclical system of Earp & Godfrey [1059 of 1949] is a 'least squares' system of the latter type. Systems of the Wullenwever kind bear a close resemblance to a least-squares system with weighting according to the signal amplitude at each aerial; the difference lies in the fact that they operate with sinusoidal functions of phase instead of linear functions."

621.396.93 **1423**

Spacing-Error Analysis of the Eight-Element Two-Phase Adcock Direction Finder.—D. N. Travers. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 63–65.) In the array described the elements are arranged on a circle, with alternate angular separations of 54° and 36°; the operating frequency range is 20 : 1. Element-spacing values $> \lambda$ may be used; bandwidth is limited by other factors, such as aerial impedance or vertical pattern, rather than spacing error.

621.396.933 **1424**

Air Safety Service at the Zürich Intercontinental Airport.—A. Fischer. (*Tech. Mitt. schweiz. Telegr.-Teleph Verw.*, 1st Nov. 1955, Vol. 33, No. 11, pp. 449–470. In German and French.) An account of the navigation aids, air traffic control and communication systems used, and of the interrelation between these services.

621.396.96 **1425**

Radar Polarization Power Scattering Matrix.—C. D. Graves. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 248–252.) An improved method is described for calculating the amount and polarization of the energy reflected from the target for arbitrary polarization of the incident wave from measurements with any one polarization.

621.396.96 : 551.578 **1426**

Airborne Weather Radar uses Isoecho Circuit.—F. W. Ruppert & J. M. Smith. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 147–149.) A light-weight equipment suitable for use in commercial aircraft is described. Return signals stronger than a pre-set level cause blacking out on the p.p.i. display, so that storm centres appear as dark areas surrounded by illumination.

621.396.962.3 **1427**

Prediction of Pulse Radar Performance.—W. M. Hall. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 224–231.) Improved range-calculation procedure is described, based on detailed reconsideration of all the terms entering into the radar equation. The procedure is particularly useful for comparisons of performance.

MATERIALS AND SUBSIDIARY TECHNIQUES

533.583 : 546.82 **1428**

Gettering of Gas by Titanium.—V. L. Stout & M. D. Gibbons. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1488–1492.) Experiments are described which indicate that Ti can be used as a getter for O_2, N_2 and CO_2 at temperatures above 700°C, for H_2 in the temperature range 25°–400°C, and for water vapour and methane at high or low temperature. Only H_2 is released by Ti on heating subsequent to sorption.

535.215 + 537.533.8 **1429**

Effect of Electron Bombardment on Secondary and Photoelectric Emission of Cesium Antimonide.—K. Miyake. (*J. phys. Soc. Japan*, Oct. 1955, Vol. 10, No. 10, pp. 912–913.) Continuation of experiments described previously (2968 of 1955). Photoelectric fatigue effects are also discussed in a separate paper (*ibid.*, pp. 913–915).

535.215 : 546.24 : 537.311.33 **1430**

Recombination Processes in Tellurium.—D. Redfield. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1094–1100.) Studies were made on single crystals with acceptor densities of about 10^{16}/cm³, using photoconductivity techniques with pulsed illumination. The results indicate that at 100°K direct recombination dominates over recombination through localized traps at all illumination levels. It is deduced that small-energy-gap materials should have long lifetimes and should be sensitive photoconductors, and that there should be an optimum value of energy gap, probably near 0·5 eV, giving maximum lifetime.

535.37 : 546.472.21 **1431**

On the Spectral Distribution of Infrared-Stimulated Phosphorescence of Pb-Activated ZnS-Type Phosphors.—S. Asano. (*J. phys. Soc. Japan*, Oct. 1955, Vol. 10, No. 10, pp. 903–905.)

535.376 : 546.472.21 **1432**

Electroluminescence of Zinc Sulfide Single Crystals.—D. R. Frankl. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1105–1111.) Measurements made using half-wave 60-c/s excitation are reported and the results are compared with those of other workers, the intensity and phase of the electroluminescence peaks being examined in detail. It is deduced that excitation occurs by impact of conduction electrons accelerated through internal barriers, that the two electroluminescence peaks in each cycle result respectively from immediate recombination and from recombination delayed by electron trapping, and that the applied field tends to hold the electron in the trap.

535.376 : 546.681.18 **1433**

Electroluminescence of GaP.—G. A. Wolff, R. A. Herbert & J. D. Broder. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1144–1145.) Experimental observations are reported; the phenomena are consistent with the impact-excitation mechanism suggested by Piper & Williams (3439 of 1952).

537.226/.228.1 : 546.431.824-31 **1434**

Effect of Firing Cycle on Structure and some Dielectric and Piezoelectric Properties of Barium Titanate Ceramics.—L. Egerton & S. E. Koonce. (*J. Amer. ceram. Soc.*, 1st Nov. 1955, Vol. 38, No. 11, pp. 412–418.) Experimental results indicate the existence of particular conditions for firing time and temperature leading to optimum grain size, as evidenced by the corresponding values of dielectric constant, piezoelectric constants and coupling coefficients. Firing cycles should be modified to suit the particular purpose for which the material is to be used. By using a special technique involving rapid heating and cooling, it is possible to prepare specimens with dielectric constants as high as 3 000 accompanied by low piezoelectric constants.

537.226/.227 : 546.431.824-31 **1435**

Phase Equilibria in the System $BaTiO_3$-SiO_2.—D. E. Rase & R. Roy. (*J. Amer. ceram. Soc.*, 1st Nov. 1955, Vol. 28, No. 11, pp. 389–395.) A comprehensive experimental investigation is reported. The existence of three intermediate compounds was established and three simple eutectics were determined. Glasses with high refractive indices were obtained over a limited range of compositions. The dependence of the cubic-hexagonal transition temperature on the SiO_2 content is discussed.

537.226 : 621.315.612.4 **1436**

X-Ray Investigation of Solid Solutions of $BaTiO_3$-$PbZrO_3$.—E. A. Porai-Koshits, N. Ya. Karasik & G. O. Gomon. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 945–946.)

537.226:621.315.616 **1437**

Artificial Dielectrics utilizing Cylindrical and Spherical Voids.—H. T. Ward, W. O. Puro & D. M. Bowie. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 171–174.) Artificial dielectrics are investigated comprising three-dimensional arrays of holes in polystyrene, teflon and other materials with relatively high mechanical strength. A theoretical expression is derived for the overall dielectric constant when the holes are spherical or cylindrical with nearly equal length and diameter; for cylindrical holes with large length/diameter ratios the dielectric constant depends on the orientation with respect to the electric field. Values of 1·1–2·6 are obtained by measurements at 5 kMc/s.

537.227 : 546.431.824-31 **1438**

Ferroelectric Hysteresis in Barium Titanate Single Crystals.—H. H. Wieder. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1479–1482.) An experimental and theoretical investigation has been made of the hysteresis loop of crystals with antiparallel domains only. Measurements were made over the temperature range −100° to +100°C. Coercivity and losses decrease sharply as the crystal passes through the phase transitions from tetragonal to orthorhombic at −10°C and from orthorhombic to trigonal at −90°C, but the loop remains rectangular. It may be possible by controlling the crystal growth to shift the orthorhombic phase to room temperature.

537.311.33 **1439**

The Transport of Injected Electrons and Holes in a Semiconductor.—R. Gevers. (*Physica*, Nov. 1955, Vol. 21, No. 11, pp. 888–896.) Laplace-transformation technique is used to solve differential equations describing the transport of added current carriers in a homogeneous semiconductor. For time intervals much greater than the relaxation time, the result agrees with that derived by Keilson (753 of 1954) using a different method. An effective diffusion coefficient and a mobility value applicable to the establishment of charge neutrality during the relaxation time are introduced. The value of the small local space charge occurring during the transport period is calculated. The polarizability of the injected pairs when the applied field is alternating is discussed.

537.311.33 : 546.23/.24 : 539.26 **1440**

Soft X-Ray Absorption of Tellurium and Vitreous and Metallic Selenium.—M. P. Givens, C. J. Koester & W. L. Goffe. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1112–1115.) Measurements are reported and the results are discussed in relation to the density of states in the conduction band.

537.311.33 : 546.28 + 546.289 **1441**

Crystal Cutting.—T. H. Kinman & C. Hayward. (*B. T.-H. Activ.*, Sept./Oct. 1955, Vol. 26, No. 5, pp. 137–139.) A method of slicing and dicing Ge and Si crystals is described, using a multiple tungsten-wire cutter.

537.311.33 : 546.28 **1442**

Electrical Properties of Near-Degenerate Boron-Doped Silicon.—R. O. Carlson. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1075–1078.) Measurements have been made of resistivity and Hall effect in single-crystal Si specimens with B content in the range 10^{18}–10^{19} atoms/cm³. The anomalous Hall mobility effect previously observed by Morin & Maita (750 of 1955) was studied over the temperature range 25°–300°K. For degenerate samples the Hall mobility is about 46 cm/s per V/cm at 300°K.

537.311.33 : 546.289 **1443**

Minority Carrier Extraction in Germanium.—R. Bray. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1047–1055.) A method of carrier extraction is discussed in which special contacts are used to limit the entry of minority carriers into the specimen while offering no barrier to majority carriers. Almost complete depletion of minority carriers was obtained with electric fields of strength well under 50 V/cm using samples 1–2 cm long with minority-carrier lifetime of the order of 100 μs. Resistance at 65°C was increased as much as

13-fold, corresponding to extraction of about 90% of all the carriers, for a specimen with room-temperature resistivity of 32 Ω.cm. This method of extraction has been termed 'exclusion' by Low (3296 of 1955).

537.311.33 : 546.289 **1444**

Removal of Copper from Germanium.—K. B. Blodgett. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1520–1521.) Samples of *n*-type Ge were first coated with Cu which was allowed to diffuse into the interior. Experiments were then made on removing the Cu by heating the samples at 700°C (*a*) in O_2 atmosphere, (*b*) in H_2 atmosphere, or (*c*) in H_2, the samples being coated with an iron salt. The results indicate that the coating in method (*c*) serves as a 'sink' for the Cu; by cleaning off the surface and applying a fresh coating the Cu content can be reduced repeatedly.

537.311.33 : 546.289 **1445**

A Study of the Etching Rate of Single-Crystal Germanium.—P. R. Camp. (*J. electrochem. Soc.*, Oct. 1955, Vol. 102, No. 10, pp. 586–593.) Experiments were made using etchants composed mainly of H_2O_2, HF and water. The temperature variation of the etching rate is consistent with the assumption that two surface reactions take place in sequence. Crystal orientation is significant. From the etching data, the thickness of the surface layer disturbed by abrasive grinding was estimated to be 2–10 μ.

537.311.33 : 546.289 **1446**

Electrolytic Etching at Small-Angle Grain Boundaries in Germanium.—S. G. Ellis. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1140–1141.) "There is a difference of appearance between *n*-type and *p*-type germanium crystals which have been anodically etched. This can be explained if only the hole current contributes to the etching. An *n*-type crystal can be made to etch in the same way as a *p*-type crystal if injected holes reach the crystal-electrolyte interface. Hole-electron recombination within the crystal can then reduce the rate of etching. Such recombination at small-angle grain boundaries has been demonstrated."

537.311.33 : 546.289 **1447**

Electron Microscopy of Etched Germanium Surfaces.—J. W. Allen & K. C. A. Smith. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 439–443.) Examination of Ge surfaces, etched by a reagent whose activity depends on the presence of free carriers, reveals raised areas which may mark the emergence of edge dislocations.

537.311.33 : 546.289 **1448**

Variation of the Conductivity of Germanium by an External Electric Field.—S. G. Kalashnikov & A. E. Yunovich. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 952–954.) Negative charges were induced on thin plates of Ge, and the conductivity of the plates was measured. Considerable variation was observed, depending on the type of Ge used and on the previous surface treatment (polishing or etching). These experiments show that surface treatment considerably alters the surface states, and also that the normally observed hole conductivity of the surface layer is changed into electronic conductivity when paraffin wax is present at the surface.

537.311.33 : 546.289 : 535.215 **1449**

Longitudinal Photomagnetoelectric Effect in Germanium.—J. Aron & G. Groetzinger. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1128–1129.) "The e.m.f. developed parallel to the gradient of light absorption (Dember e.m.f.) in a germanium crystal is reduced by the application of a transverse magnetic field, the diminution being about 10% for a field of 5 000 gauss. The size of the effect is approximately quadratic in the field up to about 2 000 gauss, is then linear to 4 000 gauss, and subsequently saturates."

537.311.33 : 546.289 : 537.228 **1450**

Temperature Dependence of the Elastoresistance in *n*-Type Germanium.—R. W. Keyes. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1104–1105.) A more extensive study of the temperature dependence of the elastoresistance of *n*-type Ge than that reported by Smith (2418 of 1954) indicates that the elastoresistance is inversely proportional to absolute temperature, in agreement with theory developed e.g. by Herring (2642 of 1955).

537.311.33 : 546.289 : 538.214 **1451**

Magnetic Susceptibility of Germanium.—D. K. Stevens, J. W. Cleland, J. H. Crawford, Jr, & H. C. Schweinler. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1084–1093.) An experimental investigation covering the frequency range 70°–300°K is reported. High-purity specimens exhibit decreasing diamagnetism with increasing temperature. The charge-carrier susceptibility for *n*- and *p*-type specimens is found by comparing the observations with those for the pure Ge at the same temperature. Deductions are made regarding the charge-carrier masses and the nature of the energy surfaces. The specimens examined included one of *n* type which had been bombarded by fast neutrons.

537.311.33 : 546.289 : 539.89 **1452**

Conductivity, Hall Effect, and Magnetoresistance in *n*-Type Germanium, and their Dependence on Pressure.—G. B. Benedek, W. Paul & H. Brooks. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1129–1139.) Measurements have been made over the pressure range 1–10 000 kg/cm². The results are interpreted in terms of a low-field theory based on a shape parameter of the energy ellipsoids and on the dependence of collision time on energy. Effects due to impurities are considered.

537.311.33 : 546.289 : 621.314.7 **1453**

Transistor Fabrication by the Melt-Quench Process.—J. I. Pankove. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 185–188.) A method is described for forming *p*-*n* junctions close to one another in a bar of impurity-doped Ge by partly melting the material and re-solidifying it. The method is distinguished from that described by Pfann (2125 of 1954) by the high speed of the solidifying process, which may be > 0·85 cm/s.

537.311.33 : 546.289 : 621.396.822 **1454**

Noise in Germanium.—S. Okazaki & H. Oki. (*J. phys. Soc. Japan*, Oct. 1955, Vol. 10, No. 10, pp. 910–912.) Observations were made on thin single-crystal specimens over the frequency range 100 kc/s–100 Mc/s, using a heterodyne circuit with square-law detector and c.r.o. The excess current noise varies with frequency according to a $1/f^{\beta}$ law, where β is always > 1 and most often about 2. The noise figure at 100 kc/s is 10–20 dB when the current passed is 5 mA.

537.311.33 : 546.3-1-28-289 **1455**

Magnetoresistance of Germanium-Silicon Alloys.—M. Glicksman. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1146–1147.) Measurements have been made

on *n*-type crystals with various compositions. The results are consistent with the energy-band structure suggested by Herman (460 of 1955).

537.311.33 : 546-3-1-28-289 : 538.569.4 **1456**

Cyclotron Resonance in Ge-Si Alloys.—G. Dresselhaus, A. F. Kip, Han-Ying Ku, G. Wagoner & S. M. Christian. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1218–1219.)

537.311.33 : 547 **1457**

The Semiconductivity of Organic Substances: Part 2.—D. D. Eley & G. D. Parfitt. (*Trans. Faraday Soc.*, Nov. 1955, Vol. 51, No. 395, pp. 1529–1539.) The resistance of crystalline organic substances in vacuo has been determined by an a.c. method. The results are used to determine the energy gaps for intrinsic semiconductivity in *iso*dibenzanthrone (0·96 eV), α:α-diphenyl β-picryl hydrazyl (0·26 eV) and metal-free phthalocyanine (1·49 eV). An impurity conductivity has been detected in phthalocyanine at temperatures up to about 150°C. Possible conduction mechanisms are discussed. Part 1: *ibid.*, 1953, Vol. 49, pp. 79–86 (Eley et al.).

537.311.33 : 621.314.7 **1458**

Transistor Physics.—W. Shockley. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 23–41.) Text of the 46th Kelvin lecture. Crystal imperfections basic to transistor operation are indicated and the technology of controlling these imperfections to produce desired properties is discussed.

538.221 **1459**

On the Origin of Magnetic Anisotropy induced by Magnetic Annealing.—S. Chikazumi & T. Oomura. (*J. phys. Soc. Japan*, Oct. 1955, Vol. 10, No. 10, pp. 842–849.) The anisotropy induced by annealing was measured as a function of the composition of Fe-Ni alloys for various cooling rates. The results are not compatible with theories of 'strain in directional order' or of 'elongated order phase', but are consistent with a theory of dipole-dipole interaction differing with different sorts of atomic pairs.

538.221 **1460**

Effect of Shape Anisotropy on the Coercive Force of Elongated Single-Magnetic-Domain Iron Particles.—T. O. Paine, L. I. Mendelsohn & F. E. Luborsky. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1055–1059.) Experiments have been made on elongated particles with diameters around 150 Å, produced by an electro-deposition method. Direct correlation was observed between the coercive force and the length/diameter ratio of the particles.

538.221 **1461**

An Approach to Elongated Fine-Particle Magnets.—I. S. Jacobs & C. P. Bean. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1060–1067.) The relation between the coercive force and the shape of elongated single-domain particles is examined in the light of experimental results obtained by Paine et al. (1460 above). A 'chain-of-spheres' model is presented by means of which the processes involved can be explained.

538.221 **1462**

The Fluctuating Field Model of Ferromagnetism with Particular Reference to Nickel.—F. D. Stacey. (*Canad. J. Phys.*, Nov. 1955, Vol. 33, No. 11, pp. 661–667.)

538.221 **1463**

Influence of Carbon in Solution on the Magnetic Properties of Soft Iron and 3·5% Si Iron Alloys.—A. Ferro & G. Montalenti. (*Ricerca sci.*, Oct. 1955, Vol. 25, No. 10, pp. 2828–2833.) Armco and other alloys were investigated. The percentage of free carbon is deduced from magnetic relaxation measurements. The differences in behaviour are related to the different mobility of free carbon in the Si-Fe matrix.

538.221 **1464**

Investigation of Nucleation Centres of Reverse Magnetization in Silicon Iron Crystals.—Ya. S. Shur & V. R. Abel's. (*C. R. Acad. Sci. U.R.S.S.*, 21st Nov. 1955, Vol. 105, No. 3, pp. 469–471. In Russian.) An experimental study, by the powder-pattern method, of domain formation on reverse magnetization. Specimens of 4%-Si iron 0·1–0·2 mm thick were used. See also 470 of 1955 (Goodenough) and *Proc. phys. Soc.*, 1st Feb. 1953, Vol. 66, No. 398A, pp. 162–166 (Bates & Martin).

538.221 : 538.632 **1465**

The Spontaneous Hall Effect in Ferromagnetics: Part 1.—J. Smit. (*Physica*, Nov. 1955, Vol. 21, No. 11, pp. 877–887.) The effect is investigated analytically and experimentally; measurements at different temperatures suggest that it is closely related to the resistivity of the material. An explanation of the effect is advanced based on an isotropic scattering of conduction electrons by lattice imperfections.

538.221 : 546.74 **1466**

Influence of the Internal State on the Position of the Poles in Magnetized Nickel Wires.—C. Schwink. (*Z. Phys.*, 18th Nov. 1955, Vol. 143, No. 2, pp. 205–218.) The influence of stresses and texture on the position of magnetic poles was investigated using an electron-optical method [2465 of 1954 (Marton et al.)]. The results in the region of plastic deformation can be explained on present-day theories of the behaviour of polycrystalline metals; in the region of mixed plastic-elastic deformations results are explained by assuming an easily deformable surface layer of thickness about 0·03 mm.

538.221 : 621.318.134 **1467**

Origin of the Uniaxial Anisotropy in Iron-Cobalt Ferrites.—S. Iida, H. Sekizawa & Y. Aiyama. (*J. phys. Soc. Japan*, Oct. 1955, Vol. 10, No. 10, p. 907.)

538.221 : 621.318.134 **1468**

Note on an Investigation of the Anomalous Time-Constant of certain Iron-Deficient Magnesium Manganese Ferrites.—L. C. F. Blackman & N. P. R. Sherry. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 385–388.) Experiments on MgMn ferrites having Fe deficiencies of 10%–40% show that the dielectric constant, and possibly also the resistivity, of the material is critically dependent on firing temperature, showing a pronounced peak corresponding to temperatures between 1 330° and 1 380°C. The effect diminishes as the Fe content is increased and is not present in the stoichiometric material.

538.221 : 621.376.32 **1469**

Measurements of Reversible Permeability and their Theoretical Interpretation.—H. Wilde. (*Z. angew. Phys.*, Nov. 1955, Vol. 7, No. 11, pp. 509–513.) A variometer having a ferrite core and a magnetizing coil with high-μ core was used as an oscillator at a mean

frequency of 75 Mc/s in experiments to determine how useful such an arrangement would be as an u.s.w. frequency modulator. The frequency/excitation-current characteristic is of 'butterfly' form, the splitting being due to hysteresis. The relation between the main curve and the modulation loops obtained at different values of bias current is investigated. The field-strength variation of the overall reversible permeability determined by calculating the contributions from the elementary domains before and after wall movements is in good agreement with measured values.

538.569.3.029.63/.64 **1470**

Broadband Absorbing Materials.—W. H. Emerson, A. G. Sands & M. V. McDowell. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section 1, pp. 74–75 ..137.) An experimental investigation of microwave absorption by spun mats of animal hair impregnated with a special rubber solution is reported. A typical value of the reflection factor for an 8-in.-thick mat on a metal base is $< 2\%$ at 500 Mc/s. Percentage-reflection curves are given for two specimens at frequencies up to 10 kMc/s and above.

538.569.4 : 546.87 **1471**

Cyclotron Absorption in Bismuth.—R. N. Dexter & B. Lax. (*Phys. Rev.*, 15th Nov. 1955, Vol. 100, No. 4, pp. 1216–1218.)

538.639 : 546.87 : 537.311.31 **1472**

Effect of Small Admixtures on Galvanomagnetic Properties of Bismuth.—N. E. Alekseevski, N. B. Brandt & T. I. Kostina. (*C. R. Acad. Sci. U.R.S.S.*, 1st Nov. 1955, Vol. 105, No. 1, pp. 46–49. In Russian.) The magnetoresistance effect in Bi with traces of Sn and Te impurities was investigated experimentally at normal and at 1 750 atm pressure, at low temperatures. Results are presented graphically. See also 3632 of 1955 (Alekseevski & Brandt).

549.514.51 **1473**

Investigation of Piezoelectric Oscillations of Quartz by X-Ray Diffraction.—R. Mermod. (*Helv. phys. Acta*, 15th Nov. 1955, Vol. 28, Nos. 5/6, pp. 543–562. In French.)

549.514.51 : 537.226 **1474**

Dielectric Constant of Quartz as a Function of Frequency and Temperature.—M. R. Stuart. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1399–1404.) Measurements were made over the temperature range 20°–400°C, at frequencies from 1 to 90 kc/s, with the electric field directed along the optic axis. Results are presented graphically and discussed in relation to the hypothesis that ions are displaced in 'tunnels' parallel to the optic axis.

621.315.61 **1475**

Dielectric Absorption due to Water of Crystallization in Pinacol Hydrate.—J. S. Cook & R. J. Meakins. (*Trans. Faraday Soc.*, Nov. 1955, Vol. 51, No. 395, pp. 1483–1488.) Results are reported of dielectric measurements made at frequencies between 5 c/s and 50 Mc/s, at various temperatures. The dielectric absorption and dispersion decrease rapidly with decreasing water content.

621.315.61 : 546.287 **1476**

Silicone Insulants.—J. D. Hayden. (*Electronic Engng*, Feb. & March 1956, Vol. 28, Nos. 336 & 337, pp. 58–63 & 115–119.) An illustrated review of properties and applications.

621.315.616 **1477**

An Investigation into the Relaxation Processes in Polyvinyl Acetate at Temperatures below the Softening Temperature.—P. F. Veselovski & A. I. Slutsker. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 939–942.) Measurements of the dielectric properties of the material were carried out over a temperature range from $-150°$ to $+20°$C and a frequency range from 50 to 10^{10} c/s. Experimental curves are shown.

621.318.22 : 538.221 **1478**

A Method of preparing Iron Powder for Permanent Magnets.—E. H. Carman. (*Metallurgia, Manchr*, Oct. 1955, Vol. 52, No. 312, pp. 165–168.)

621.791.3 **1479**

The Significance of Contact-Angle Measurements in Soldering.—N. R. Srinivasan & H. S. Aswath. (*J. Indian Inst. Sci.*, Section B, Oct. 1955, Vol. 37, No. 4, pp. 293–303.)

MATHEMATICS

517.93 **1480**

Uniformly Almost Periodic Solutions of Non-linear Differential Equations of the Second Order: Part 1—General Exposition.—C. Obi. (*Proc. Camb. phil. Soc.*, Oct. 1955, Vol. 51, Part 4, pp. 604–613.)

MEASUREMENTS AND TEST GEAR

621.3.018.41(083.74) + 529.786 **1481**

The Unit for Frequency.—J. Hers. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 260–261.) Bullard's suggestion to adopt a new definition of the second (3686 of 1955) is deprecated. It is suggested that the unit of frequency, to be termed the hertz, should be defined independently of the second as the 9 192 632th part of Cs frequency. A more precise value could be adopted later by international agreement; the value should be such that one hertz would equal one cycle per second at some convenient date.

621.3.018.41(083.74) : 621.396.9 **1482**

Frequency Variations in New Zealand of 16-kc/s Transmissions from GBR Rugby.—A. H. Allan, D. D. Crombie & W. A. Penton. (*Nature, Lond.*, 28th Jan. 1956, Vol. 177, No. 4500, pp. 178–179.) The frequency of the received signal has been compared with that of a local standard crystal oscillator adjusted to be about 3 parts in 10^7 fast; the beats were recorded continuously. Specimen records illustrate the diurnal distribution of the apparent frequency variation of the transmitted signals. The frequency of WWVH as measured at the same site [*J. Instn elect. Engrs*, Oct. 1955, Vol. 1, No. 10, pp. 650–651 (Allan)] shows variations at least one order greater than those of GBR.

621.317.3 : 621.314.7 **1483**

Measuring R.F. Parameters of Junction Transistors.—W. N. Coffey. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 152–155.) "Equipment and techniques for measuring small-signal h parameters of triode and tetrode junction transistors in the range from 1 to 24 Mc/s are described."

621.317.3 : 621.396.822 **1484**

Measurement of Electrical Fluctuations with the Aid of Thermoelectric Devices.—V. I. Tikhonov. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 817–822.) It is suggested that thermocouples and thermistors may

be used as standard noise sources for measurement of noise spectra. The theory of the method is discussed and a formula (16) is derived expressing the accuracy of the measurements. A brief report is also given on an experiment.

621.317.312 **1485**

The Exact Measurement of Alternating Currents.—G. Trautner. (*Arch. Elektrotech.*, 30th Aug. 1955, Vol. 42, No. 2, pp. 94–99.) An arrangement is described using a Wheatstone bridge with one load-dependent resistance and an ordinary vibration galvanometer as null indicator. After initial calibration with d.c., an a.c. of e.g. 170 mA can be determined to within 0·04%.

621.317.32 **1486**

Time-Voltage Pulse Discriminator.—C. E. Lowe. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 178..186.) A circuit is described whose sensitivity is not affected by the absolute magnitude of the compared voltages. The difference component is detected as a series of pulses by the use of an alternating reference voltage in a bridge network.

621.317.32 : 621.385.032.216 **1487**

Arrangement for the Measurement of Low Alternating Voltages by the Compensation Method.—A. Vanavermaete. (*Helv. phys. Acta*, 15th Nov. 1955, Vol. 28, Nos. 5/6, pp. 522–524. In French.) A description is given of a circuit designed primarily for measuring the conduction properties of oxide cathode coatings.

621.317.382.029.6 : 538.632 **1488**

The Hall Effect and its Application to Power Measurement at Microwave Frequencies.—H. E. M. Barlow & L. M. Stephenson. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 110–112.) Experiments were made on a crystal of *n*-type Ge mounted in a cavity resonator magnetically coupled to a rectangular waveguide, so that the crystal was immersed in a microwave field; a current proportional to the microwave electric field was passed through the crystal at right angles to the microwave magnetic field. The time average of the Hall e.m.f. observed under these conditions was approximately proportional to the power in the waveguide. The method can be used under any conditions of load without absorbing more than a small fraction of the power being transmitted.

621.317.7 : 621.397.6 **1489**

A Test-Signal Generator for Measurements on Television Transmission Systems.—O. Macek. (*Frequenz*, Nov. 1955, Vol. 9, No. 11, pp. 380–386.) The signals provided by the equipment discussed are those recommended by the German Funk-Betriebs-Kommission; these are compared with those recommended by the C.C.I.F.

621.317.7.089.6 : 621.311.6 **1490**

An Electronic Supply for Use in the Calibration of Instruments.—Wilkins & Harkness. (See 1554.)

621.317.727 : 681.142 **1491**

A Digital Potentiometer.—Dean & Nettell. (See 1314.)

621.317.729 **1492**

The Rubber Membrane and Resistance Paper Analogies.—J. H. O. Harries. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 236–248.) Methods of investigating fields by means of rubber-membrane and resistance-paper models are reviewed; precautions necessary to avoid errors are indicated.

621.317.742 **1493**

Standing-Wave Detector with a Helix-Line Element.—F. J. Tischer. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section I, pp. 70–71..134.) The detector comprises an insulated helix wound on a metal cylinder. This reduces the wave velocity by a factor of 10, resulting in an extension of the useful range to below 500 Mc/s.

621.317.755 **1494**

The Recording of High-Speed Single-Stroke Electrical Transients.—D. R. Hardy, B. Jackson & R. Feinberg. (*Electronic Engng*, Jan. & Feb. 1956, Vol. 28, Nos. 335 & 336, pp. 8–12 & 75–79.) A review of developments during the last 20 years, covering c.r. tubes, auxiliary circuits and photographic techniques. 81 references.

621.317.755 : 621.385.832 **1495**

A Precision Cathode-Ray Oscillograph with a Spot Diameter of a few μ.—M. von Ardenne. (*Nachr-Tech.*, Nov. 1955, Vol. 5, No. 11, pp. 481–489.) Detailed description of an instrument in which the oscillograms are photographed at normal size; the area of the spot is about 10^{-3} times that of the screen. A reduced image of the first cross-over is produced by an auxiliary magnetic lens, and a slightly magnified image of this second cross-over is produced by the main magnetic lens. Reproduced oscillograms of various phenomena indicate the degree of detail attainable.

621.317.761 : 538.569.4 **1496**

Broadband Microwave Frequency Meter.—P. H. Vartanian & J. L. Melchor. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 175–178.) An arrangement is described depending on paramagnetic resonance in α,α-diphenyl β-picryl hydrazyl; its operating range is from 600 Mc/s upwards through the X band. The hydrazyl is contained in a 2-in. section of coaxial line placed in a longitudinal magnetic field. A c.r.o. indication of resonance is obtained as the magnetic field is swept up to 4 kG. Frequencies 8 Mc/s apart in the S band can be resolved, and single frequencies can be determined to within $\pm$ 1 Mc/s.

621.317.761.029.51/.63 **1497**

Wide-Range Heterodyne Frequency Meter.—W. C. Reichard. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section I, pp. 86–87..149.) A description is given of a meter for the range 10 kc/s–1·040 kMc/s developed for the U.S. Signal Corps. The range is covered by using the harmonic output of a modified Hartley oscillator with fundamental ranges 125–250 kc/s and 2·5–5 Mc/s and of a particular version of the Colpitts circuit with fundamental range 65–130 Mc/s. Schematic and block diagrams are given.

621.317.79 : 621.396.822 **1498**

Automatic Noise-Factor Meter.—H. Wallman. (*Chalmers tek. Högsk. Handl.*, 1955, No. 161, 17 pp.) A null method is described based on the principle of balancing amplifier noise against $\frac{1}{2}$ (amplifier noise + noise-diode noise); the advantage over other standard methods is that the only source of systematic error lies in the calibration of the 3-dB attenuator used.

621.317.794 **1499**

Metal-Resistance Bolometers at Low Temperatures.—K. Bischoff, E. Justi, M. Kohler & G. Lautz. (*Z. Naturf.*, May 1955, Vol. 10a, No. 5, pp. 401–412.) Sensitivity can be improved by operating at an appropriate low temperature; using a Ni-foil element, the sensitivity at 90°K is ten times as great as at room temperature. The problem is discussed in relation to measurements of long-wave infrared radiation, and the effect of interrupting the radiation is considered.

621.319.4(083.74) **1500**

An Adjustable Absolute Capacitance Standard.—G. Zickner. (*Arch. Elektrotech.*, 30th Aug. 1955, Vol. 42, No. 2, pp. 71–93.) Description of the cylindrical capacitance standard of the Physikalisch-Technische Bundesanstalt. The capacitance is about 100 pF and the setting accuracy about 0·001 pF per scale division. The absolute value can be estimated to within 0·15% in the least favourable circumstances.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

550.8 : 534.2-8 **1501**

The Scientific Bases for the Use of Ultrasonics in Mining and Geology.—I. Malecki. (*Acta tech. Acad. Sci., hungaricae*, 1955, Vol. 13, Nos. 3/4, pp. 397–407. In German.)

621.3-52 : 621.9 **1502**

Electronic Controls for Machine Tools.—D. A. Findlay. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 122–129.)

621.3.012.8 : 621-52 : 628.8 **1503**

Electrical Analogues for Heat Exchangers.—R. L. Ford. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 65–82.) Equivalent circuits for heat exchangers are discussed in relation to problems of automatic control. Circuits composed entirely of passive elements and circuits including amplifiers are considered.

621.317.39 : 538.221 **1504**

A High-Frequency Method for Metallurgical Investigations of Magnetic Alloys.—F. Fraunberger. (*Z. Metallkde*, Oct. 1955, Vol. 46, No. 10, pp. 749–751.) The method described is based on the marked dependence of the alloy resistivity on its crystal structure at frequencies above those at which irreversible processes play a part.

621.317.39 : 620.1.08 **1505**

The Phase Comparator.—J. C. Anderson. (*Electronic Engng*, Feb. 1956, Vol. 28, No. 336, pp. 63–65.) Description of a nondestructive method of testing steel springs by measuring the L/R ratio for a coil within which the spring is compressed.

621.384.6 **1506**

Cascade Generators for Particle Acceleration up to 4 MeV.—W. Heilpern. (*Helv. phys. Acta*, 15th Nov. 1955, Vol. 28, Nos. 5/6, pp. 485–491. In German.) Circuit modifications leading to reduced ripple and internal resistance are described.

621.384.6 + 621.387.4] : 539.1(44) **1507**

Nuclear Energy and its Industrial Applications: Part 2—Particle Accelerators and Nuclear-Physics Apparatus.—(*Onde élect.*, Nov. 1955, Vol. 35, No. 344, pp. 955–1115.) This issue comprises a further group of papers on subjects including particle counters and other electronic apparatus and techniques involved in nuclear physics. Part 1: 958 of March.

621.384.611/.612 **1508**

Nonlinear Regenerative Extraction of Synchrocyclotron Beams.—K. J. Le Couteur & S. Lipton. (*Phil. Mag.*, Dec. 1955, Vol. 46, No. 383, pp. 1265–1280.) Analysis indicates that a nonlinear deflector can extract the beam with higher energy and perhaps greater theoretical efficiency than the linear one used hitherto in the Liverpool machine. See also 873 of March.

621.384.612 **1509**

The Influence of Magnetic-Field Errors on Betatron Oscillators in the Strong-Focusing Synchrotron.—G. Lüders. (*Nuovo Cim.*, 1955, Supplement to Vol. 2, No. 4, pp. 1075–1146. In German.) Summarized report of research carried out for the European Organization for Nuclear Research up to the autumn of 1953.

621.385.833 **1510**

Investigation of Focusing Properties of Cylindrical Magnetic Lenses and Systems comprising such Lenses.—S. Ya. Yavor. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 779–790.)

621.385.833 **1511**

Determination of the Magnetic Field for focusing Electron Beams of a Given Type.—I. I. Tsukkerman. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 853–860.) The limitations are established which are imposed on the magnetic field of a curvilinear electron-optical system when the axial trajectory of the beam and the electric field adjacent to this trajectory are given, and also when it is required to obtain a real similar image in a given normal plane. Examples are given of the design of some purely magnetic electron-optical systems (systems with spiral, circular and straight-line axes).

621.385.833 **1512**

Variable-Magnification Magnetic Electron-Optical Systems free from Image Rotation.—Tsukkerman. (See 1598.)

621.385.833 **1513**

Numerical Calculation of the Induction in a Magnetic Electron Lens causing No Image Rotation.—M. Laudet. (*C. R. Acad. Sci., Paris*, 14th Dec. 1955, Vol. 241, No. 24, pp. 1728–1730.)

621.385.833 **1514**

100-keV Electrons in the Electrostatic Electron Microscope (Intermediate Accelerator).—G. Möllenstedt. (*Optik, Stuttgart*, 1955, Vol. 12, No. 10, pp. 441–466.) Description of an instrument in which the cathode potential is − 50 kV and the object potential is + 50 kV, so that the electrons are incident on the object with an energy of 100 keV, while the energy of electrons striking the viewing screen is arranged to be only 50 keV.

621.385.833 **1515**

New Quantitative Methods in Electron-Optical Shadow Technique.—C. Schwink. (*Optik, Stuttgart*, 1955, Vol. 12, No. 11, pp. 481–496.) Continuation of previous work [1536 of 1954 (Rollwagen & Schwink)].

The finite divergence of the illuminating beam is taken into account. Possible methods of improving the sensitivity are discussed.

621.387.464 **1516**

Characteristics of the Optical Arrangement of a Scintillation Counter.—Y. Koechlin. (*J. Phys. Radium*, Nov. 1955, Vol. 16, No. 11, pp. 849–853.) An investigation is made of the possibility of increasing the fraction of the scintillation light reaching the cathode of the photomultiplier cell by providing the scintillator with a diffusing coating; the influence of geometric factors is also studied.

621.398 : 631.3 **1517**

Radio-Controlled Tractor.—(*Engineer, Lond.*, 7th Oct. 1955, Vol. 200, No. 5202, pp. 518–519.) A system demonstrated near London used a battery-operated 27·12-Mc/s transmitter with six non-simultaneous channels, provided by tone modulation, respectively controlling the steering left and right, clutch release, implement raising and lowering, and engine stop. The receiver has tuned-reed relays.

621.398 : 681.142 **1518**

A Transducer for Digital Data-Transmission Systems.—R. H. Barker. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 42–51.) Transducers for target-coordinate representation, for weapon control systems, have been constructed to represent the angular position of a shaft as a 14-digit binary number, i.e. to an accuracy of rather better than one minute of arc. Photoelectric scanning is used. Possible errors are discussed.

537.228.1 : 621.317.39 **1519**

Einführung in die piezoelektrische Messtechnik. [Book Review]—W. Gohlke. Publishers: Akademische Verlagsgesellschaft Geest & Portig, Leipzig, 1954, 241 pp., DM 21. (*Z. angew. Phys.*, Nov. 1955, Vol. 7, No. 11, p. 555.) This introduction to piezoelectric measurements constitutes the eighth volume of a series of monographs, and provides a detailed treatment of the fundamentals and applications of the subject.

PROPAGATION OF WAVES

621.396.11 **1520**

The Shielding of Radio Waves by Conductive Coatings.—E. L. Hill. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 72–76.) The subject is discussed with particular reference to shielding effects experienced in aircraft where conducting coatings are provided on external surfaces to prevent charge accumulation; wavelengths considered are long compared with openings in the aircraft skin.

621.396.11 : 551.510.535 **1521**

The Interaction of Pulsed Radio Waves in the Ionosphere.—J. A. Fejer. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 322–332.) Preliminary daytime measurements using low-power transmitters and a receiver on a common site are discussed. The electron density and collision frequency and the energy-loss coefficient are deduced from the theory of Bailey & Martyn (2168 of 1935 and back references). The resulting collision-frequency values agree with laboratory determinations by Crompton et al. (106 of 1954) and with a value obtained from work on partial reflections by Gardner & Pawsey (132 of 1954). The electron densities are near those obtained by Gardner & Pawsey. The energy-loss coefficient, obtained in the present case for electrons of low excess energy, is much higher than the values found by Crompton et al. working with electrons having high excess energies. The results appear to agree better with the original Bailey-Martyn theory than with the alternative form suggested by Huxley (231 of 1954).

621.396.11 : 551.510.535 **1522**

On the Level at which Fading is imposed on Waves Reflected Vertically from the Ionosphere.—H. G. Booker. (*J. atmos. terr. Phys.*, Dec. 1955, Vol. 7, No. 6, pp. 343–344.) By comparing theoretical with experimental autocorrelation functions for plane waves incident normally upon a diffracting screen, it is shown that fading is imposed upon the wave within, or near, the reflecting stratum; scattering by irregularities in this region plays an important part in the propagation of the wave.

621.396.11 : 551.510.535 **1523**

Some Results of a Sweep-Frequency Propagation Experiment over an 1150-km East-West Path.—B. Wieder. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 395–409.) Experiments using a pulsed frequency-sweep ionosphere recorder at each of the end points and another at the mid-point of the great-circle path show that the transmission-curve-derived F_2-layer m.u.f. is up to 5% too low, depending on time of day and season.

621.396.11 : 551.510.535 **1524**

Sweep-Frequency Pulse-Transmission Measurements over a 2400-km Path.—P. G. Sulzer. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 411–420.) Analysis of results of experiments similar to those detailed by Wieder (1523 above) shows propagation on numerous occasions during the winter of 1953–1954 at frequencies considerably above the m.u.f. calculated from vertical-incidence observations at the mid-point of the path.

621.396.11 : 551.510.535 **1525**

Heights of Irregularities giving Rise to the Fading of 150-kc/s Waves.—Banerji. (See 1415.)

621.396.11 : 551.510.535 **1526**

Polarization of Electromagnetic Waves for Vertical Propagation in the Ionosphere.—R. Roy & J. K. D. Verma. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 457–482.) A solution is given of the wave equations obtained e.g. by Saha et al. (1442 of 1948), and the orientation of the polarization ellipses is deduced. Electron density and collision frequency in the ionized layers are deduced from the value of the tilt angle and the ratio of the ellipse axes. Applied to experimentally obtained patterns, the theory gives a value of $1{\cdot}7 \times 10^6$/sec for the collision frequency in the E layer.

621.396.11 : 551.510.535 **1527**

Regularly-Observable Aspect-Sensitive Radio Reflections from Ionization aligned with the Earth's Magnetic Field and located within the Ionospheric Layers at Middle Latitudes.—A. M. Peterson, O. G. Villard, Jr, R. L. Leadabrand & P. B. Gallagher. (*J. geophys. Res.*, Dec. 1955, Vol. 60, No. 4, pp. 497–512.) The reflection geometry and the characteristics of echoes received at frequencies between 6 and 30 Mc/s suggest that the phenomenon is caused by a type of particle bombardment generally similar to that which is believed to cause the aurora.

621.396.11 : 551.594.6 : 523.78 **1528**

The Influence of the Solar Eclipse on the Propagation of Atmospherics in the Frequency Range 5–30 kc/s.—Skeib. (See 1466.)

621.396.11.029.51 : 551.510.535 **1529**

Long-Range Propagation of Low-Frequency Radio Waves between the Earth and the Ionosphere.—J. Shmoys. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 163–170.) "The problem of modes of propagation of electromagnetic waves between a perfectly conducting earth and a gradually varying ionosphere is considered. The case of exponentially varying ionospheric parameters is solved in terms of Bessel functions. The propagation constant, the angle of arrival and the group velocity are calculated for the first few modes of propagation."

621.396.11.029.6 **1530**

Synthesis of Radio Signals on Overwater Paths.—A. H. LaGrone, A. W. Straiton & H. W. Smith. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 48–52.) The fluctuations of microwave radio signals on overwater paths are correlated with variations in water level. The signal-strength variations will contain the first, second and third harmonics of the water-level cycles. An expression is derived relating the cross-correlation function of signal-strength variations at two vertically spaced aerials with variations of spacing.

621.396.11.029.62 **1531**

Radio Transmission Loss vs Distance and Antenna Height at 100 Mc/s.—P. L. Rice & F. T. Daniel. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 59–62.) Curves based on extensive observations are given which are considered to be more precise than those published in 1949 by the F.C.C. Ad Hoc Committee [see 3524 of 1949 (Lewis)].

621.396.11.029.62 **1532**

Coverage Conditions for TV and F.M. Stations elucidated by Field-Strength Charts.—K. Steen-Andersen. (*Teleteknik, Copenhagen*, Nov. 1955, Vol. 6, No. 4, pp. 205–221.) The preparation and method of use of field-strength charts is described. Statistical information gathered by the Danish Post Office is used as basis for a discussion of field-strength distribution inside and outside buildings. Interference of various types is considered. The field-strength values and interference protection conditions laid down at the 1952 Stockholm conference are given for comparison.

621.396.11.029.62 : 551.594.5 **1533**

V.H.F. Auroral and Sporadic-E Propagation from Cedar Rapids, Iowa, to Ithaca, New York.—R. Dyce. (*Trans. Inst. Radio Engrs*, April 1955, Vol. AP-3, No. 2, pp. 76–80.) Analysis of continuous records, taken over the period April 1952–May 1954, of reception of a 50-Mc/s transmission show that auroral propagation occurred during 4·77% of the time and propagation by E_s during 0·82% of the time.

RECEPTION

621.396.621 : 621.376.33 **1534**

A Locked-Oscillator Quadrature-Grid F.M. Sound Detector.—J. Avins & T. Brady. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 648–655.) The circuit described uses a pentode valve with sharp-cut-off suppressor characteristic. A.m. rejection and static limiting are provided at high signal level by grid damping and degeneration, and at low signal level by operation of the circuit as a locked oscillator.

621.396.621 : 621.376.5 : 621.396.41 **1535**

Electrical Pulse Communication Systems: Part 3—Transmission and Reception Problems in Pulse Systems.—Filipowsky. (See 1546.)

621.396.722 **1536**

Extendible Long-Distance Receiver Installations for Telegraph Services.—W. Hasselbeck. (*Telefunken Ztg*, Sept. 1955, Vol. 28, No. 109, pp. 162–171. English summary, p. 196.) A series of rack-mounted units is described including the s.w. receivers Type E127, Type E104 and Type E305, receiver Type E108 (10 kc/s–1·8 Mc/s), a teleprinter keying unit, dual-diversity combining unit, double-current power supply unit, etc. Racks are cabled for the maximum number of units, switches in the rack cabling being actuated automatically on inserting a unit. The build-up of installations for reception of various types of transmission is illustrated.

621.396.82.029.51 : 621.317.729 : 621.314.7 **1537**

A Radio Interference Measuring Set using Point-Contact Transistors.—J. N. Barry & G. W. Secker. (*Electronic Engng*, Feb. 1956, Vol. 28, No. 336, pp. 53–57.) Circuit and detailed description of a portable battery-operated unit designed to measure interference in the long-wave band due to harmonic radiation from television line timebase circuits. The instrument is essentially a superheterodyne receiver with i.f. 90 kc/s. The minimum input signal for reliable readings is one giving an output signal/noise ratio of 10 dB, viz. 1 μV in 75 Ω or 15 μV in 15 kΩ.

621.396.821 : 551.594.6 **1538**

The Effect of Atmospherics on Tuned Circuits.—A. G. Edwards. (*J. Brit. Instn Radio Engrs*, Jan. 1956, Vol. 16, No. 1, pp. 31–39.) From a general analysis of the effect of an aperiodic signal on a tuned system the Fourier component at the resonance frequency is determined. Available information on the lightning discharge is summarized, and an estimate is made of the spectrum of the waveform radiated from the main return stroke and its variation at different distances from the source. Experiments are described in which atmospherics received from distant and close sources were recorded simultaneously in tuned and untuned channels. The results are consistent with predictions from earlier work when allowance is made for scatter in source distance.

621.396.828 **1539**

Radio Interference Control in Aircraft.—A. L. Albin & J. McManus. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section 1, pp. 76–77..124.) Methods of interference control at frequencies up to several kMc/s are discussed. The importance of proper bonding and screening of openings by copper mesh is stressed. The use is suggested of waveguide attenuators for holes for control shafts and other openings up to 1 in. diameter. 11 references to U.S. military standards and special reports.

STATIONS AND COMMUNICATION SYSTEMS

621.376.5 : 534.781 **1540**

Laboratory Equipment for Quantizing Speech.—V. H. Allen. (*Electronic Engng*, Feb. 1956, Vol. 28, No. 336, pp. 48–52.) Details are given of a trigger unit and quantizing unit used in investigating the fine structure of speech waveforms and the effect of distortion on intelligibility. The operation of the units in a delta modulation system is described; with this system, good intelligibility was preserved with quantizing frequencies down to 5 kc/s.

621.39 **1541**

A Review of Line and Radio-Relay Communication Systems.—H. Stanesby. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 11–17.) The

evolution of long-distance communication systems is outlined and the work on international standardization carried out by the C.C.I.F. and the C.C.I.R. is mentioned.

621.39.001.11 **1542**

Methods of sampling Band-Limited Functions.—R. S. Berkowitz. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 231–235.) "A family of signals is considered which lie within a bandwidth of W c/s. Methods are discussed of experimentally obtaining suitable discrete numbers at the rate of $2W$ per second to describe completely any given member of the family. An 'Educated Direct' sampling method is presented and compared with previously known sampling methods."

621.391.1 : 621.376.23 : 621.397.2 **1543**

Transient Response of Detectors in Symmetric and Asymmetric Sideband Systems.—Murakami & Sonnenfeldt. (See 1566.)

621.394.14 **1544**

Investigation of a Special Transformation of the Teleprinter Alphabet as a Transformation of Vectors.—E. Henze. (*Arch. elekt. Übertragung*, Nov. 1955, Vol. 9, No. 11, pp. 528–532.) A simple method of privacy coding is discussed.

621.396.41 **1545**

A New Low-Power Single-Sideband Communication System.—E. A. Laport & K. L. Neumann. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 635–647.) Description of a simple system, Type SSB-1, for simplex or duplex operation on telephony or telegraphy over short or medium distances.

621.396.41 : 621.376.5 : 621.396.621 **1546**

Electrical Pulse Communication Systems: Part 3—Transmission and Reception Problems in Pulse Systems.—R. Filipowsky. (*J. Brit. Instn Radio Engrs*, Jan. 1956, Vol. 16, No. 1, pp. 40–58.) Various time-division multiplex systems are discussed, synchronous and asynchronous systems being compared. The use of functional multiplexing (CODEF) to reduce redundancy is described. When choosing a system for a particular purpose, limitations in power radiation must be considered. Effects due to various types of noise are discussed; regenerative repeating is the most important method for overcoming these effects in long-range systems. Special detection methods and frequency- and time-selection methods for separating the signal from the noise are reviewed. 56 references. Part 2: 562 of February.

621.396.41.029.6 : 621.3.018.78 **1547**

R.F. Bandwidth of Frequency-Division Multiplex Systems using Frequency Modulation.—R. G. Medhurst. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 189–199.) The frequency distribution of energy in f.m. microwave multiplex systems is analysed and an examination is made of the extent of intermodulation distortion caused by limiting the bandwidths of the r.f. networks in the system. The results are used to determine the minimum filter bandwidths for given permissible distortion.

621.396.65.029.6 + 621.397.26 **1548**

The Austrian Radio-Link Network for Television and U.S.W. Broadcasting.—(*Radio Tech., Vienna*, Oct./Nov. 1955, Vol. 31, Nos. 10/11, pp. 335–340.) The special planning problems encountered in Austria are discussed and a brief account is given of the equipment so far installed. The system operates mainly in the 2-kMc/s band.

621.396.712 : 534.861 **1549**

Design of Studios for Small Broadcasting Stations.—Goodsman. (See 1295.)

621.396.73 : 621.396.61/.62 **1550**

Portable Radiotelephone Sets.—H. Muth & G. Ulbricht. (*Telefunken Ztg*, Sept. 1955, Vol. 28, No. 109, pp. 143–149. English summary, p. 194.) Sets are generally designed for eight hours continuous service (transmission time 26%), using p.h.m. in the 80-Mc/s or 160-Mc/s band, with up to 12 switch-selected channels. Operating costs are lowest using a vibrator power pack with lead-acid accumulators. Details are given of two recently developed sets. Applications are described in the following papers:—

"Teleport" Portable F.M. U.S.W. Radiotelephone Sets in Industry.—W. Leisner (pp. 150–153. English summary, pp. 194–195).

Portable Radiotelephone Sets in the Operation of Railways.—A. Schepp & F. Pepping (pp. 154–159. English summary, p. 195).

Use of Portable Radiotelephone Sets on Airfields (pp. 159–161. English summary, pp. 195–196).

621.396.931 **1551**

Multichannel Networks in the Public Mobile Radiotelephone Service.—K. H. Deutsch. (*Funk-Technik, Berlin*, Oct. 1955, Vol. 10, No. 19, pp. 556–557.) A discussion of the maximum number of mobile stations which can conveniently share one or two channels. The number, which varies between 45 and 70 per channel in the U.S.A., is likely to be smaller in Germany; limited experience on one network indicates a maximum of about 35. Use of two channels and suitable switching nearly trebles this maximum for the same average delay time.

SUBSIDIARY APPARATUS

621-52 : 621.375.3 **1552**

Magnetic-Amplifier Two-Speed Servo System.—J. J. Suozzi. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 140–143.) A system is described in which two half-wave bridge-type magnetic-amplifier stages drive a full-wave slave-type output stage. Design data are presented for a number of systems.

621-526 **1553**

A Servo System for Digital Data Transmission.—R. H. Barker. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 52–64.) The stability of the servo system is affected by the quantized nature of the digital data and by time delays inherent in the transmission and digital systems. A method of synthesis is discussed enabling a degree of prediction to be incorporated which ensures that the regenerated data do not lag on the original data under steady-state conditions.

621.311.6 : 621.317.7.089.6 **1554**

An Electronic Supply for Use in the Calibration of Instruments.—F. J. Wilkins & S. Harkness. (*Proc. Instn elect. Engrs*, Part B, Jan. 1956, Vol. 103, No. 7, pp. 83–92.) Description of a high-power oscillator/amplifier set, with phase-shift unit, giving an output of at least 700 VA at unity power factor within the range 30 c/s–5 kc/s from each of two amplifiers. The output voltage does not vary by more than 0·01% during the time taken to calibrate a point on an instrument scale.

621.311.6 : 621.373.52 **1555**

Transistor Power Converter Capable of 250 Watts D.C. Output.—G. C. Uchrin. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 261–262.) A unit

based on the circuit described previously [974 of 1955 (Uchrin & Taylor)] has been developed giving 250 W output from a 24-V input. Experimental performance figures are given.

621.314.5 : 621.387 **1556**

Thyratron Inverter uses Controlled Firing Time.—F. Lawn. (*Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 164–167.) The circuit described permits control of a.c. output voltage without saturable reactor, with improved regulation, efficiency and response speed. One thyratron serves as control tube for extinguishing the conducting power tube at any desired phase.

TELEVISION AND PHOTOTELEGRAPHY

621.397.26 + 621.396.65.029.6 **1557**

The Austrian Radio-Link Network for Television and U.S.W. Broadcasting.—(See 1548.)

621.397.5 : 535.623 **1558**

A New Look at Colorimetry.—D. L. MacAdam. (*J. Soc. Mot. Pict. Telev. Engrs*, Nov. 1955, Vol. 64, No. 11, pp. 629–630. Discussion, pp. 630–631.) An account of the proceedings at the meeting of the International Commission on Illumination (C.I.E.) in June 1955, at which the revision of colorimetry standards was discussed. The relevance of the problem to colour television is briefly indicated.

621.397.5 : 535.623 **1559**

Survey of the Various Colour-Television Systems.—E. Schwartz. (*Arch. elekt. Übertragung*, Nov. 1955, Vol. 9, No. 11, pp. 487–504.) The systems discussed include the N.T.S.C., the two-colour-subcarrier, and the coding method [1815 of 1953 (Valensi)]. 185 references.

621.397.5 : 535.623 **1560**

The Moscow Colour-Television Experiments.—A. M. Warbanski (Varbanski). (*NachrTech.*, Nov. 1955, Vol. 5, No. 11, pp. 490–492.) German adaptation of paper noted previously (582 of February). The standards used are 525 lines, 25 complete pictures per sec, corresponding to 150 frames of each colour per sec. The picture-carrier frequency is 78 Mc/s and the width of the video channel 8·4 Mc/s.

621.397.5 : 778.5 **1561**

Television Signal Recording.—W. Woods-Hill. (*Wireless World*, March 1956, Vol. 62, No. 3, pp. 127–130.) A recording system using 35-mm microfilm moving at normal or twice-normal film speed is outlined. The recording is made via a c.r. tube in which the time-base applied to the X plates is synchronized with the line pulses, and a 15-Mc/s voltage applied to the Y plates is modulated by the picture signal. The image is projected with its height optically reduced so as to occupy $< 1/20$ of the height of the film frame, and the sweep is adjusted to occupy the total usable width. Reproduction is effected by means of a photoelectric pick-up system.

621.397.6 : 621.317.7 **1562**

A Test-Signal Generator for Measurements on Television Transmission Systems.—Macek. (See 1489.)

621.397.62 **1563**

Television Receiver with Continuously Variable Tuning.—A. V. J. Martin. (*Télévision*, Nov. 1955, No. 58, pp. 271–272.) A Belgian version of the Boncourt all-standards receiver is described. The layout follows normal practice except for the timebase system, in which two thyratron relaxation oscillators are used which can be tuned to synchronization according to the relevant standards, and the continuous-tuning feature. The television bands I (40–70 Mc/s) and III (164–220 Mc/s) are covered, alternative receiver bandwidths of about 4 and 8 Mc/s being provided.

621.397.62 : 621.314.26.029.62 **1564**

Simplified Band-III Converter.—O. E. Dzierzynski. (*Wireless World*, March 1956, Vol. 62, No. 3, pp. 134–139.) A single-stage converter using a triode-pentode frequency changer, designed for use in areas of high signal-strength, is described in detail.

621.397.62 : 621.314.7 **1565**

Transistorized Sync Separator Circuits for Television Receivers.—H. C. Goodrich. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 533–550.) Double clipping of synchronizing signals can be achieved in a circuit using only one junction transistor as a result of the low-voltage knee in the characteristic. The immunity of the circuit to impulse noise can be improved by including a diode to control the circuit time constant. The performance is satisfactory for ordinary commercial receivers.

621.397.62 : 621.391.1 : 621.376.23 **1566**

Transient Response of Detectors in Symmetric and Asymmetric Sideband Systems.—T. Murakami & R. W. Sonnenfeldt. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 580–611.) Analysis is presented indicating the advantages of the synchronous detector over the envelope detector, with special reference to asymmetric-sideband systems for television. General formulae are particularized for the triple-stagger-tuned band-pass filter for different modulation levels. Observations of the transient performance of synchronous detectors are described.

621.397.621.2 : 535.623 : 621.385.832 **1567**

Improvement in Color Kinescopes through Optical Analogy.—D. W. Epstein, P. Kaus & D. D. VanOrmer. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 491–497.) "In color kinescopes wherein the phosphor dots are deposited by the conventional optical exposure, the movement of the deflection center with deflection angle causes a radial misregister between the phosphor dots and electron spots. This misregister has been eliminated by interposing a thin aspheric lens between the light source and the aperture mask during exposure of the phosphor screen in the manufacture of the tube."

621.397.7 **1568**

Low-Power Telecasting.—M. E. Williamson & S. E. Rodby. (*J. Soc. Mot. Pict. Telev. Engrs*, Nov. 1955, Vol. 64, No. 11, pp. 618–621.) Short account of the development of inexpensive television stations for the U.S. armed forces. An area of radius about 5 miles can be served using equipment with about 30 W effective radiated power.

621.397.7 **1569**

Copenhagen Television Station.—J. Hansen & I. L. Nielsen. (*Teleteknik, Copenhagen*, Nov. 1955, Vol. 6, No. 4, pp. 197–204.) A description is given of the station arrangement; some details are included on the transmitters and aerial.

621.397.8 **1570**

Image Gradation, Graininess and Sharpness in Television and Motion-Picture Systems: Part 4 A & B—Image Analysis in Photographic and Television Systems (Definition and Sharpness).—

O. H. Schade. (*J. Soc. Mot. Pict. Telev. Engrs*, Nov. 1955, Vol. 64, No. 11, pp. 593–617.) 'Aperture theory' is developed. The properties and combination of 'apertures' (point images) can be described in the space domain by transmittance functions and in the frequency domain by their Fourier spectra (sine-wave response). The basic operation of image formation and analysis is the convolution of two functions. The 'equivalent pass-band' is a significant parameter. Part 3: 1233 of 1954.

TRANSMISSION

621.376.222 **1571**

Why Fight Grid Current in Class B Modulators? —J. L. Hollis. (*Proc. Instn Radio Engrs, Aust.*, Nov. 1955, Vol. 16, No. 11, pp. 397–401.) Reprint. See 3249 of 1953.

621.376.32 : 538.221 **1572**

Measurements of Reversible Permeability and their Theoretical Interpretation.—Wilde. (See 1469.)

621.396.61.004 **1573**

Unattended Broadcasting Transmitters.—W. J. Baker. (*Brit. Commun. Electronics*, Nov. 1955, Vol. 2, No. 11, pp. 64–68.) Techniques developed for unattended operation are briefly reviewed. Important aspects are use of air-cooled valves, automatic monitoring, and devices for protection against failure.

VALVES AND THERMIONICS

621.314.63 **1574**

A Note on the Small-Amplitude Transient Response of *P-N* Junctions.—B. R. Gossick. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, p. 259.) Analysis indicates that when the forward bias is sufficient to make the barrier *RC* time constant small compared with the average recombination time, the response is very fast.

621.314.63 : 546.289 **1575**

Capacitance Measurements on Alloyed Indium-Germanium Junction Diodes.—D. R. Muss. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1514–1517.) "Donor densities in the base material of fused junction diodes, inferred from capacitance data, are used to calculate majority carrier mobilities. The dependence of capacitance on reverse bias at very low biases is found to be given by the sum of two terms, a space charge capacitance and a capacitance due to the flow of holes as given by Shockley's low level *p-n* junction theory."

621.314.63 : 621.396.822 **1576**

Spectral Analysis of Flicker Noise of Ge Diodes at Low Frequencies.—J. P. Borel, C. Manus & R. Mercier. (*Helv. phys. Acta*, 15th Nov. 1955, Vol. 28, Nos. 5/6, pp. 454–458. In French.) Noise measurements were made at 10 kc/s, 1·7 kc/s, 167 c/s and 16·6 c/s; calibration was performed using a resistor noise source. The apparatus gave a direct reading of the mean-square value of noise current. Results indicate that this mean-square value varies with the diode reverse current according to a power law which depends on the frequency; consequently the spectral distribution of the noise depends on the diode current.

621.314.7 **1577**

The Frequency Response of Bipolar Transistors with Drift Fields.—L. B. Valdes. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 178–184.) Details of charge-carrier transport in point-contact transistors are discussed. The frequency variation of current multiplication is calculated taking account of the distribution of transit time of minority carriers between emitter and collector. The absolute transit time depends on both drift and diffusion effects, but the distribution depends only on diffusion. Calculated results are compared with measurements.

621.314.7 : 537.311.33 **1578**

Transistor Physics.—Shockley. (See 1458.)

621.314.7 : 621.317.3 **1579**

Measuring R.F. Parameters of Junction Transistors.—Coffey. (See 1483.)

621.383.27 **1580**

Feedback in Photoelectron Multipliers.—L. G. Leiteizen & N. S. Khlebnikov. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 943–944.) It was found that a photoelectron multiplier with a semi-transparent Sb-Cs cathode had a low noise level and an amplification factor of the order of 10^6–10^7 at a voltage of 1–1·2 kV. Attempts to increase secondary emission by raising the voltage were ineffective owing to optical feedback. By making certain constructional improvements the amplification factor was raised to 10^8.

621.385 : 621.396.822 **1581**

Theory of Shot Effect.—M. E. Gertsenshtein. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 827–833.) Mean values of noise current in a valve are evaluated from the local fluctuations of the convection current.

621.385 : 621.396.822 **1582**

Correlation of Fluctuations in an Electron Gas. —M. E. Gertsenshtein. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 834–840.) Continuation of analysis (1581 above). Methods are indicated for calculating the correlation tensor (1) for an electron gas with arbitrary electron-velocity distribution; this is required for determining the shot-noise intensity.

621.385.029.6 **1583**

Space-Charge Waves in Accelerated and Decelerated Unidimensional Electron Streams.—R. Müller. (*Arch. elekt. Übertragung*, Nov. 1955, Vol. 9, No. 11, pp. 505–512.) Analysis is given for a system in which the potential distribution along the electron stream can be represented by a simple power law. For practical conditions the space-charge waves can be considered as distorted sine waves.

621.385.029.6 **1584**

Space-Charge Distribution in a Static Magnetron. —H. C. Nedderman. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1420–1430.) A method of investigation is described based on photoelectric measurement of the radiation intensity from gas atoms in the interaction space excited by electron collisions. The results indicate that space charge extends to the anode under all conditions. A considerable fraction of the space charge consists of electrons trapped for long times.

621.385.029.6 **1585**

Space-Charge Waves in Crossed Electric and Magnetic Fields.—S. S. Solomon. (*J. appl. Phys.*, Dec. 1955, Vol. 26, No. 12, pp. 1443–1449.) Analysis shows that growing waves can be propagated along a neutralized beam in crossed fields by converting either the kinetic or the potential energy of the electrons into wave energy. In the former case the TE and TM modes are coupled in general, but the coupling coefficient is

negligible for electron velocities much smaller than the velocity of light. In the latter case, which is that of the travelling-wave magnetron, the TE and TM modes are uncoupled even when the electron velocity is comparable with the velocity of light.

621.385.029.6 **1586**

Magnetron Theory.—D. Gabor & G. D. Sims: R. Q. Twiss. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 449–452 & 454–456.) Buneman's criticisms (939 of March) of previous papers by the authors (3787 and 3785 of 1955) are answered.

621.385.029.6 **1587**

Self-Sustained Electronic Spokes in Magnetrons.—A. Raev, I. Uzunov & A. Angelov. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 452–454.) Conditions are described in which oscillations occurring in two- and four-segment magnetrons appear to be due to a rotating electronic 'spoke' which is self-sustained without a tuned circuit. Similar oscillations have also been found with a single-anode magnetron.

621.385.029.6 **1588**

X-Band Klystrons for High-Power C.W. Operation.—H. S. Cockroft & J. R. Pickin. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 359–372.) Description of the construction and performance of amplifiers with up to 2 kW output and oscillators with 500 W output.

621.385.029.6 **1589**

Design Information on Large-Signal Traveling-Wave Amplifiers.—J. E. Rowe. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, pp. 200–210.) Formulae are derived for high-power operation of travelling-wave valves taking account of space charge. The parameters considered are the relative injection velocity, the gain parameter, the input level, the space-charge parameter and the space-charge-range parameter. Results are presented graphically.

621.385.029.6 **1590**

E- and C-Type Traveling-Wave Devices.—P. Guénard & O. Doehler. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, p. 261.) Comment on 3436 of 1955 (Heffner & Watkins).

621.385.029.6 : 621.373.4 **1591**

Generation of Electromagnetic Oscillations by means of a Travelling-Wave Valve with an External Helix.—V. S. Mikhalevski & D. N. Venerovski. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 812–816.) An experimental investigation was conducted to establish the conditions for excitation of oscillations as determined by the pitch of the helix, the mean velocity of electrons and the intensity of the magnetic focusing field, for an assumed electron-velocity distribution. The experimental results are in agreement with the theoretical conclusions.

621.385.029.6 : 621.376 **1592**

Klystron Modulation and Schlömilch Series.—J. R. M. Vaughan. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 430–438.) Amplitude modulation of the output of a klystron oscillator, whose frequency is varied by modulation of the reflector voltage, is investigated theoretically by use of the Schlömilch series of Bessel functions; the conclusions are verified by experiment.

621.385.029.6 : 621.396.822 **1593**

Analysis of Noise in Electron Beams.—F. N. H. Robinson & H. A. Haus. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 373–384.) Extension of analysis presented previously [3442 of 1955 (Haus & Robinson)]. Linear systems, including amplifiers with lossy circuits and those with beams involving more than two modes of propagation, are discussed. The minimum noise figure of any beam-type amplifier can be calculated from a knowledge of the propagation modes and associated power flow.

621.385.029.6 : 621.396.822 **1594**

Interception Noise in Electron Beams at Microwave Frequencies.—W. R. Beam. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 551–579.) Theory is developed particularly for pencil beams and intercepting elements with round apertures, on the basis of an assumed transverse distribution of probability of electron interception. Results of experiments support the assumptions made. Partial interception of the beam gives rise to two noise components, due respectively to velocity and current fluctuations.

621.385.029.6.032.213 **1595**

A High-Temperature Cantilever-Cathode for Noise Investigations of 8-mm C.W. Magnetron.—A. E. Barrington. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 421–429.) A tantalum cathode operating at 1 900°C and heated by hydrogen ion bombardment (see 2798 of 1955) is described. Experiments show that noise is critically dependent on the value of the magnetic field, on mismatch and on cathode position.

621.385.2 : 621.316.722.1 **1596**

Saturated Diodes.—D. L. Hall: D. M. Sutherland: F. A. Benson & M. S. Seaman. (*Electronic Engng*, Feb. 1956, Vol. 28, No. 336, pp. 84–85.) Comments on 3447 of 1955 and authors' reply.

621.385.832.032.2 **1597**

Experimental High-Transconductance Gun for Kinescopes.—F. H. Nicoll. (*RCA Rev.*, Dec. 1955, Vol. 16, No. 4, pp. 612–617.) "Use of electroformed fine mesh on the control grid aperture of an experimental electron gun gives an order of magnitude reduction in required video drive. Focus and current characteristics are acceptable for many applications."

621.385.833 **1598**

Variable-Magnification Magnetic Electron-Optical Systems free from Image Rotation.—I. I. Tsukkerman. (*Zh. tekh. Fiz.*, May 1955, Vol. 25, No. 5, pp. 950–952.) Design theory is presented. One of the simplest systems satisfying the requirements is the so-called solenoid lens giving unity magnification. The results obtained could be applied to television cameras for altering the scale of the image.

621.387 : 621.37 **1599**

Some New Microwave Control Valves employing the Negative Glow Discharge.—D. H. Pringle & E. M. Bradley. (*J. Electronics*, Jan. 1956, Vol. 1, No. 4, pp. 389–404.) See also 2579 of 1955 (Pringle) and back reference.

MISCELLANEOUS

061.3 : 621.3 **1600**

Some Thoughts on Technical Meetings.—R. M. Fano. (*Proc. Inst. Radio Engrs*, Feb. 1956, Vol. 44, No. 2, p. 260.) A short discussion on the best methods of organizing meetings and literature within the I.R.E. to serve (*a*) researchers in a particular field, (*b*) those engaged on detailed practical developments, and (*c*) those interested in the broad lines of progress in the field.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.213 **1601**

The Transmission of a Plane [acoustic] Wave between Parallel Plates.—I. D. Campbell. (*Acustica*, 1955, Vol. 5, No. 6, pp. 298–302.) Analysis is presented taking account of viscosity and thermal conduction. An approximate method is used which allows the attenuation and phase velocity to be deduced for all frequencies. Results are compared with measured values.

534.232-14-8: 534.133 **1602**

The Performance of a Quartz Oscillator in Liquids.—S. Parthasarathy & V. Narasimhan. (*Z. Phys.*, 12th Dec. 1955 & 10th Jan. 1956, Vol. 143, Nos. 3 & 5, pp. 300–311 & 623–631. In English.) The ultrasonic output was determined by a calorimetric method. The efficiency of conversion was investigated in various liquids at frequencies of 2·8, 4·9, 8·7 and 14·7 Mc/s.

534.6-8 **1603**

A Reverberation Method for the Measurement of the Absorption of Ultrasonics in Liquids.—L. E. Lawley & R. D. C. Reed. (*Acustica*, 1955, Vol. 5, No. 6, pp. 316–322.)

534.79 **1604**

Loudness of Steady Noises.—E. Zwicker & R. Feldtkeller. (*Acustica*, 1955, Vol. 5, No. 6, pp. 303–316. In German.) A method of determining the loudness of sustained noises is described based on subjectively derived equal-loudness contours, the measured bandwidth of the frequency groups into which the ear analyses the noise, and the mutual reduction effect of the adjacent groups.

534.846.4 **1605**

Sound Amplification in Reverberant Spaces.—A. F. B. Nickson. (*Aust. J. appl. Sci.*, Dec. 1955, Vol. 6, No. 4, pp. 476–485.) A system of vertical columns of loudspeakers, as proposed by Parkin & Taylor (1506 of 1952), is considered best. Three practical cases of improvements thus effected are described, and curves are given showing correct dimensions and positioning of columns for halls of various lengths.

534.86: 621.375.2.029.3 **1606**

Phase Shift and Sound Quality.—J. Moir. (*Wireless World*, April 1956, Vol. 62, No. 4, pp. 165–168.) Experiments on the toleration of phase shifts in a.f. amplifiers are reported. Results indicate that phase shifts introduced by typical domestic amplifiers are of little practical importance.

621.395.612.4 **1607**

The Design of a Ribbon-Type Pressure-Gradient Microphone for Broadcast Transmission.—D. E. L. Shorter & H. D. Harwood. (*B.B.C. Engng Div. Monographs*, Dec. 1955, No. 4, pp. 1–22.) Detailed account of development work leading to the production of microphone Type PGS, with reduced size and weight and improved response.

621.395.623.5 **1608**

The Natural Frequencies of Horns.—T. Lange. (*Acustica*, 1955, Vol. 5, No. 6, pp. 323–330. In German.) Calculations and measurements have been made of the input impedance of a system comprising a pressure chamber, a cylindrical connection, and a hyperbolic or catenoidal horn. In the general case the combined effects of the pressure chamber and the horn shape produce inharmonic resonances, but the two effects can be balanced to produce harmonic resonances.

621.395.625.3: 534.76 **1609**

Design of Magnetic Recording and Reproducing Equipment for Domestic Use with Special Reference to Stereophonic Reproduction.—M. B. Martin & D. L. A. Smith. (*J. Brit. Instn Radio Engrs*, Feb. 1956, Vol. 16, No. 2, pp. 65–77. Discussion, pp. 77–79.)

681.84.534.851 **1610**

Sapphire and Diamond Needles for reproducing Gramophone Disks.—P. H. Werner. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Dec. 1955, Vol. 33, No. 12, pp. 504–511. In French.) Tests are reported to determine the playing time of both sapphire and diamond needles before quality of reproduction deteriorates noticeably. Photographs of unused and used needles are reproduced. The higher cost of the diamond needles is out of proportion to their longer service except for professional users. Where diamond needles are used, special precautions must be taken in respect of their finish.

AERIALS AND TRANSMISSION LINES

621.372.029.6 **1611**

Symposium on Microwave Strip Circuits.—(*Trans. Inst. Radio Engrs*, March 1955, Vol. MTT-3, No. 2, pp. 1–177.) The text is given of 22 papers presented at a symposium held in October 1954; stripline, microstrip and tri-plate lines and components using them are described. Abstracts of all the papers are given in *Proc. Inst. Radio Engrs*, July 1955, Vol. 43, No. 7, pp. 894–895.

621.372.2 : 621.385.029.6 **1612**

Coupled Helices.—J. S. Cook, R. Kompfner & C. F. Quate. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 127–178.) An analysis of coupled helices is presented, based on transmission-line and field theory. Applications based on the presence of one and of both normal modes of propagation are described, and curves and equations useful in the design of travelling-wave valves and other microwave equipment are presented.

621.372.2.012 **1613**

New Diagram for solving Impedance Transformations.—R. Guillien. (*Onde élect.*, Dec. 1955, Vol. 35, No. 345, pp. 1164–1170.) If the reflection coefficient of a transmission line is represented by its logarithm, the standard Smith chart may be replaced by a logarithmic chart of orthogonal curves on which impedance transformations may be effected by simple translation, avoiding the rotations required on the Smith chart.

621.372.22 : 621.372.51 **1614**

Nonuniform Transmission Lines as Impedance Transformers.—J. Willis & N. K. Sinha. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 166–172.) "The equation for the reflection coefficient at one end of a nonuniform transmission line matched at the other end is considered, and an approximate form of solution is suggested which enables such lines to be designed for optimum performance as matching sections. A number of examples are calculated, and the results are compared with lines previously described in literature." See also 664 of March.

621.372.8 : 621.318.134 **1615**

Energy Concentration Effects in Ferrite-Loaded Waveguides.—J. L. Melchor, W. P. Ayres & P. H. Vartanian. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 72–77.) The influence of geometric factors on the microwave transmission characteristics for the two circularly polarized waves in a circular waveguide with an axially mounted ferrite rod are studied. The results support the prediction by Fox & Weiss (*Rev. mod. Phys.*, Jan. 1953, Vol. 25, No. 1, pp. 262–263), made in a comment on a paper by Hogan (*ibid.*, pp. 253–262), that the energy concentration within the ferrite is greater for one of the circularly polarized waves than for the other.

621.396.67 **1616**

Folded Unipole Antennas.—J. Leonhard, R. D. Mattuck & A. J. Poté. (*Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 111–116.) Analysis for folded unipoles less than $\lambda/4$ in length as input impedance transformers is presented and verified by experiment. Practical applications are proposed.

621.396.67 **1617**

A New Interpretation of the Integral-Equation Formulation of Cylindrical Antennas.—C. T. Tai. (*Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 125–127.) The conventional solution, based on an approximate integral equation, is verified by a method using the exact equation for a cylindrical shell; the new method is applicable to relatively thick aerials.

621.396.67 : 621.315.62 **1618**

A New Type of Aerial Insulator for High Voltages and Tensile Stresses.—W. Peters. (*Nachrichtentech. Z.*, Dec. 1955, Vol. 8, No. 12, pp. 632–635.) An insulator for use in stays of mast aerials is described; the optimum distribution of the insulators along the stays is indicated.

621.396.67 : 621.396.969 **1619**

Reflection of Electromagnetic Waves from Thin Metal Strips (Passive Antennae).—Lindroth. (See 1731.)

621.396.677.3 **1620**

Use of Folded Monopoles in Antenna Arrays.—J. B. Lewis. (*Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 122–124.) "A method of calculating the driving point impedances from the self and mutual impedances of related unfolded elements is given."

621.396.677.45 **1621**

Ground-to-Air Antenna uses Helical Array.—V. J. Zanella. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 161–163.) An u.h.f. aerial producing vertical polarization and consisting of a multi-element appropriately phased helical array gave a beam width at half-power points of 20° in the vertical plane and 45° in the horizontal plane. Constructional features for keeping the wind loading low are described.

621.396.677.51 : 621.318.134 : 621.396.93 **1622**

Ferrite Aerials for Goniometer Direction Finders.—G. Ziehm. (*Telefunken Ztg*, Dec. 1955, Vol. 28, No. 110, pp. 227–234. English summary, p. 265.) A discussion of the design of d.f. aerials for aircraft. The numerical calculations refer to a frequency of 300 kc/s and a magnetic field strength of 0·15 A/m. Arrangements of parallel rods offer advantages.

621.396.677.71 **1623**

The Radiation Field produced by a Slot in a Large Circular Cylinder.—L. L. Bailin. (*Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 128–137.) The results obtained by Silver & Saunders (1588 of 1950) are used in the computation of tables giving the magnitude and phase of the principal component of the far-zone electric field for $\lambda/2$ slots.

621.396.677.81.012.12 **1624**

Radiation of Electric Vibrators located near an Ideally Conducting Elliptic Cylinder.—G. N. Kocherzhevski. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1140–1154.) Polar diagrams of the vibrators are calculated by determining the total field as a sum of the fields of incident (plane) and diffracted waves and then

applying the principle of reciprocity. The cases of longitudinal, transverse and radial vibrators are considered separately and a study is made of the effects of the shape and size of the cylinder and of the position of the vibrator. A comparison is made between the theoretical and experimental polar diagrams; under certain conditions good agreement is obtained.

621.396.677.833 **1625**

Effect of Arbitrary Phase Errors on the Gain and Beam-Width Characteristics of Radiation Pattern.—D. K. Cheng. (*Trans. Inst. Radio Engrs*, July 1955, Vol. AP-3, No. 3, pp. 145–147.) Expressions applicable to microwave parabolic reflectors are derived giving the maximum reduction of gain and the maximum change in main-lobe beam-width when the peak value of the aperture phase deviation and the amplitude distribution function are known.

621.396.677.833 **1626**

Design and Construction of Double-Curvature Reflectors.—L. Thourel. (*Onde élect.*, Dec. 1955, Vol. 35, No. 345, pp. 1153–1163.) A practical method for calculating the contours of a surface with given reflecting properties is presented and the effect on the radiation pattern of varying the position of the primary source is examined. Diffraction is taken into account. Calculated patterns agree with experimental results.

621.396.677.833.1 **1627**

Parabolic Cylinder Aerials.—K. Foster. (*Wireless Engr*, March 1956, Vol. 33, No. 3, pp. 59–65.) For cm-λ aerials the ratios of whose beam-widths in two orthogonal planes are greater than about 8 : 1, parabolic cylinders are more practicable than paraboloidal reflectors. The radiation pattern of the parabolic cylinder is studied theoretically and design criteria are established. Comparison with performance figures given by Kiely (1572 of 1951) indicates that the theory is accurate enough for practical purposes.

621.396.677.85 : 537.226 **1628**

Study of the Diffraction of Electromagnetic Waves by an Array of Perforated Plates.—G. Broussaud. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 42–63.) Artificial dielectrics comprising stacked metal plates with holes arranged in regular lines are investigated. The phenomena involved are conveniently represented as a series of guided propagations. With oblique incidence, the coupling between the individual guides provides an explanation of the refraction process. The critical angle at which incident energy is entirely absorbed is related simply to the hole spacing. Application of the results to the design of microwave lenses is indicated.

AUTOMATIC COMPUTERS

681.142 **1629**

Electronic Computers.—(*Elektronische Rundschau*, Oct. 1955, Vol. 9, No. 10.) The main part of this issue is devoted to a series of papers on digital computers, with titles as follows:—

Programme-Controlled Computers.—H. J. Dreyer (pp. 341–343).

From the Punched-Card Computer to the EDPM [electronic data-processing machine].—O. Schröter (pp. 344–348).

Micro-program Control Mechanism.—H. Billing & W. Hopmann (pp. 349–353).

The Parallel Adding Mechanism of the PERM [programmgesteuerte elektronische Rechenanlage München].—W. E. Proebster (pp. 353–359).

Printing the Results from Electronic Computers.—G. Overhoff (pp. 360–361).

Use of the Electronic Computer 'GAMMA 3' for solving Complicated Mathematical Problems.—H. Päsler (pp. 362–365).

Technical Problems in the Development of Magnetic-Drum Stores.—H. O. Leilich (pp. 365–368).

Store Resonator Circuit and Data Input and Output for the BULL Electronic Computer 'GAMMA 3'.—R. Machery (pp. 369–370).

Assessment of Quality of Rectangular [-loop] Ferrites for Electronic Computers.—O. Eckert, E. Weides & K. Wallenfang (pp. 371–374).

Development of Resistances for Electronic Apparatus.—H. Loth (pp. 375–376).

Transistors in Computer Technique.—A. Krösa & K. Ganzhorn (pp. 377–380).

Properties required in Germanium Diodes for Electronic Computers.—W. Bühler (pp. 381–382).

681.142 **1630**

The Design, Construction and Applications of Electronic Digital Computers.—E. Grundy & H. McG. Ross. (*Trans. S. Afr. Inst. elect. Engrs*, Oct. 1955, Vol. 26, Part 10, pp. 261–294.) A survey of the whole field, with a comprehensive bibliography; a wide range of actual and projected applications in science and industry is discussed, including process control and data analysis.

681.142 : 621.314.7 **1631**

A Transistor Digital Fast Multiplier with Magnetostrictive Storage.—G. B. B. Chaplin, R. E. Hayes & A. R. Owens. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 121–124.) Discussion on 3170 of 1955.

681.142 : 621.374.3 **1632**

An Electrostatic Pulse Generator.—W. Woods-Hill. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 122–123.) Pulse patterns required in electronic computers are generated by presenting a probe feeding a tuned amplifier to a suitably figured track on an insulated rotating drum carrying a r.f. voltage.

CIRCUITS AND CIRCUIT ELEMENTS

621.3 : 061.3/.4 **1633**

1954 Western Electronic Show and Convention, Los Angeles, California.—(*Trans. Inst. Radio Engrs*, Sept. 1954, PGCP-2, pp. 1–118.) The full text or an abstract is given of papers on various components, equipment and techniques presented at the Convention. Abstracts of all the papers are published in *Proc. Inst. Radio Engrs*, Dec. 1954, Vol. 42, No. 12, pp. 1819–1820.

621.3.011.22 **1634**

The Resistance of Sheets, Strips, Wires, Tubes and Coils of Various Materials at Frequencies between 10 c/s and 100 kMc/s.—J. Bachel, K. L. Lenz & O. Zinke. (*Frequenz*, Dec. 1955, Vol. 9, No. 12, pp. 401–406.) A method of calculation applicable to materials with widely different conductivities, ranging from Ag to Ge, is presented. The values of the resistance per square are found from sets of curves for material thicknesses of 0·1, 0·3 and 1 mm. Because of skin effect at high frequencies, the curves for these thicknesses cover all requirements.

621.316.82 **1635**

Concavity of Resistance Functions.—C. E. Shannon & D. W. Hagelbarger. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 42–43.) "It is proved that any

network of linearly wound potentiometers and fixed resistors has a curve of resistance *versus* shaft angle which is concave downward."

621.318.4 **1636**

Oscillations of Coupled Windings.—P. A. Abetti, G. E. Adams & F. J. Maginniss. (*Elect. Engng, N.Y.*, Nov. 1955, Vol. 74, No. 11, p. 1002.) Digest of paper in *Trans. Amer. Inst. elect. Engrs*, Part III, *Power Apparatus and Systems*, April 1955, Vol. 74, pp. 12–21. By using the mutual-inductance function, the integral-equation method of determining the natural frequencies [3483 of 1954 (Abetti & Maginniss)] is extended to take account of the effect of a transformer secondary winding.

621.318.57: 621.3.042 **1637**

The Transfluxor.—J. A. Rajchman & A. W. Lo. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 321–332.) See 3509 of 1955.

621.372.029.6 **1638**

Symposium on Microwave Strip Circuits.—(See 1611.)

621.372.412 **1639**

Variation with Temperature of Quartz Resonator Characteristics.—R. Bechmann & V. Durana. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, p. 377.) Calculations based on the temperature variation of the piezoelectric constants of AT-, BT-, CT-, DT-, and X-cut quartz resonators indicate that the AT- and DT-cut resonators are particularly suitable for use, e.g. in filters, at temperatures as high as 250°C or over.

621.372.413 **1640**

Theory of Electromagnetic Resonators of Almost Conical Shape.—A. S. Kompaneets & Yu. S. Sayasov. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1124–1131.) A mathematical investigation is carried out of E-mode oscillations in a resonator formed by a spheroid and a confocal two-sheet hyperboloid, for the case of a small ratio between the focal distance and the wavelength. Perturbation theory is modified to take into account the large deviation of the field from that in a resonator formed by a sphere and two coaxial cones.

621.372.413: 621.396.67 **1641**

Theory of Thin Aerials in Cavity Resonators.—A. V. Gaponov. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1069–1084.) Free oscillations in a cavity resonator containing thin metallic aerials or having narrow slots in its walls are considered. Formulae are derived for the natural frequency and eigenfunctions of such a system and for the decrement and Q of the resonator. The results are used in a discussion of the excitation of a cavity resonator by thin aerials. The problem is reduced to the excitation of the resonator by given external electric or magnetic currents. Several examples are considered in detail. The analysis is continued in the following paper (*ibid.*, pp. 1085–1099); both tuned and untuned aerials are considered.

621.372.5 **1642**

A Matrix Method in the Solution of Cascaded Four-Terminal Networks.—R. E. Vowels. (*Aust. J. appl. Sci.*, Dec. 1955, Vol. 6, No. 4, pp. 427–441.)

621.372.5 **1643**

The Geometrical Representation of the Parallel and the Series Reactance as a Loss-Free 'Parabolic' Quadripole.—J. de Buhr. (*Nachrichtentech. Z.*, Dec. 1955, Vol. 8, No. 12, pp. 636–641.) Further application of the method described previously (349 of February and back references).

621.372.5: 621.396.822 **1644**

Calculations with Noise Voltages: Part 2—Passage of Noise Voltages through Nonlinear Elements.—G. Bosse. (*Frequenz*, Dec. 1955, Vol. 9, No. 12, pp. 407–413.) The correlation function is used to calculate the modification suffered by a noise spectrum on passing through a quadripole with nonlinear elements. The method is based on that of Rice (440, 2168 and 2169 of 1945). The quadripole characteristic is represented as an integral; the relation between the correlation functions for input and output voltages is in the form of a double integral which can be expanded in a power series. Simple expressions are obtained when the quadripole characteristic comprises a sum of Hermite polynomials. An introduction to the various parameters used is given in Part 1, *ibid.*, Aug. 1955, Vol. 9, No. 8, pp. 258–264.

621.372.54.029.6: 621.372.8 **1645**

Design of [waveguide] **Microwave Filters with Quarter-Wave Couplings.**—G. Craven & L. Lewin. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 173–177.) "Resonator diaphragms are constructed from triplets of inductive posts, whose spacings and radii are chosen to prevent the generation of the first five non-propagating modes. This is sufficient to ensure negligible coupling at quarter-wave separation. Measurements on filters at 4 000 Mc/s indicate a satisfactory performance."

621.372.542.2 **1646**

Normalized Filter Design.—S. D. Bedrosian & R. McCoy, Jr. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 200–202, 204.) The design chart presented for composite low-pass filters permits predetermining the attenuation characteristic from trial design. Six normalized designs are presented as examples to cover a practical range of stop-band loss.

621.372.56.029.63/.64: 538.569.3 **1647**

R.F. Attenuators and Load Materials.—D. Lichtman. (*Tele-Tech & Electronic Ind.*, Nov. 1955, Vol. 14, No. 11, Section I, pp. 88, 126 . . 129.) The preparation of iron-araldite mixtures with ratios of 1 : 1 to 8 : 1 by weight is described and results of loss measurements in the frequency range 1·5–7·5 kMc/s are reported. The results are presented graphically.

621.373: 621.396.822 **1648**

A Comparison of the Noise, and Random Frequency and Amplitude Fluctuations in Different Types of Oscillator.—R. L. Beurle. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 182–189.) "The nature of the random fluctuation in the output is dependent on the form of feedback employed and the method by which the output amplitude is controlled. The frequency band over which the output power is distributed depends, however, on the relative magnitudes of signal and noise in the circuit rather than on the particular circuit employed. The conclusion is that an oscillator should be operated at as high a level as possible consistent with stability and constancy of the circuit components."

621.373.4: 621.396.822: 621.376.3 **1649**

Frequency Modulation Noise in Oscillators.—J. L. Stewart. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 372–376.) The discussion is confined to noise due to the discrete nature of the electron and the random motion of the electrons in the oscillator valve; the spectrum ranges from zero to hundreds of Mc/s. The effect of the usual band-pass filter on the noise modulation is determined and the power spectrum of the oscillator output is evaluated. The theory is applied to several types of oscillator.

621.373.421 : 621.376.32 **1650**

A Wide-Band Frequency-Modulated System with Asymmetrical 3-Phase Oscillator.—P. Kundu. (*Indian J. Phys.*, March 1955, Vol. 29, No. 3, pp. 151–160.) An analytical investigation is made of the operation of the 3-phase RC oscillator; symmetrical and asymmetrical arrangements are compared as regards linearity of modulation, modulation sensitivity and frequency stability in a f.m. system.

621.373.43 **1651**

A Phase-Controlled Oscillator.—P. G. Davis. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 101–105.) Description of an oscillator whose frequency is an exact multiple of the mains frequency; the phase relation is maintained constant by a feedback loop and phase comparator.

621.373.43 **1652**

A Particular Mode of Relaxation Oscillation in a Triode Valve.—R. Bedos & P. Jean. (*C. R. Acad. Sci., Paris*, 9th Jan. 1956, Vol. 242, No. 2, pp. 234–236.) Operation of an arrangement with a very high resistance between the grid and the point of application of grid voltage is discussed. The I_a/V_g characteristic is two-valued, giving rise to relaxation oscillations. See also 3172 of 1954 (Jean).

621.373.431.2 : 621.314.7 **1653**

Junction Transistors with Alpha Greater than Unity.—Schenkel & Statz. (See 1893.)

621.373.52 : 621.314.7 **1654**

Transistorizing Meacham-Bridge Oscillators.—S. N. Witt, Jr. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 193–195.) 1955 National Electronics Conference paper. Highly stable circuits using either point-contact or junction transistors are described, for operation at a frequency of 1 Mc/s.

621.374.3 **1655**

Experiments on the Regeneration of Binary Microwave Pulses.—O. E. DeLange. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 67–90.) A device consisting of a waveguide hybrid junction with a Si crystal diode in each arm, working at signal frequency (4 kMc/s), gives sufficient regeneration to permit transmission of signals over a long chain of repeaters, providing that the r.m.s. signal/noise ratio at each repeater is > 20 dB.

621.374.32 : 621.314.7 **1656**

High-Speed Counter uses Surface-Barrier Transistor.—E. Gott. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 174–178.) The complete circuit is given of a four-stage reversible binary counter used for decoding p.c.m. signals. The high α-cut-off frequency of the surface-barrier transistors employed permits the attainment of a counting rate of 6×10^6 pulses/sec.

621.374.4 : 621.396.91 **1657**

Time-Signal Generator employing Decade-Counting Tubes.—Y. Suguri, T. Ichida & K. Harada. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 235–238.) In a frequency-dividing circuit operated in conjunction with a frequency standard and using two decade counters to effect the last stages of division from 100 c/s to 1 c/s, fluctuation of delay time for the leading edge of the seconds output pulse is 3·5 μs, and for the trailing edge 0·1 μs or better.

621.375.2 + 621.373.4 + 621.317.3].029.6 **1658**

Disc-Seal Circuit Techniques.—J. Swift. (*J. Brit. Instn Radio Engrs*, Dec. 1955, Vol. 15, No. 12, pp. 607–622 & Feb. 1956, Vol. 16, No. 2, pp. 95–111.) Reprint. See 3541 of 1955.

621.375.23 : 621.314.222 **1659**

Stability Problems with Low-Frequency Amplifiers with Transformers in the Feedback Path.—W. Langsdorff. (*Frequenz*, Nov. & Dec. 1955, Vol. 9, Nos. 11 & 12, pp. 369–379 & 422–428.) Measurements were made of the attenuation and phase variation of typical push-pull output transformers over the frequency band 20–200 kc/s, outside the low-frequency band; the phase variation was compared with that of a minimum-phase-rotation network with the same attenuation variation. The results indicate the possibility of simplifying the stability testing of the amplifier circuit by testing the transformer as a minimum-phase-rotation network.

621.375.3 : 621-526 **1660**

Self-Balancing Magnetic Servo Amplifier.—W. A. Geyger. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 196–199.) "Positive magnetic and negative electric feedback improve performance of single-stage magnetic servo amplifier driving two-phase 400-c/s induction motor and standard position servomechanism."

621.375.3 : 621.318.57 **1661**

Magnetic Amplifiers in Bistable Operation.—L. A. Finzi & G. C. Feth. (*Elect. Engng, N.Y.*, Nov. 1955, Vol. 74, No. 11, p. 1008.) Digest of paper in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, 1955, Vol. 74. Flip-flop operation can be achieved by over-regenerative feedback. The relation of the switching cycle to the steady-state transfer characteristic is examined.

621.375.4 : 621.314.7 **1662**

A Study of Transistors connected in Parallel.—A. N. Daw. (*Indian J. Phys.*, March 1955, Vol. 29, No. 3, pp. 121–130.) The performance of the parallel combination of transistors is studied in terms of a single equivalent transistor whose parameters are related in a simple manner to those of the individual transistors. Expressions are derived for the gain and the input and output impedances for the three basic modes of operation. Results of experiments with both point-contact and junction types are in good agreement with the theoretical results.

621.375.4 : 621.376.22 : 621.314.63 **1663**

A Silicon Junction Diode Modulator.—N. F. Moody. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 94–100.) By the use of biased diodes in a specially designed bridge circuit, d.c. is converted to a.c. over a range from audio frequencies to at least 100 kc/s, with a zero stability of better than 10^{-16} W at room temperature and 10^{-8} W at 80° C.

621.376.23 : 538.569.4 **1664**

Theory of the Autodyne Detector for Paramagnetic Resonance.—F. Bruin & F. M. Schimmel. (*Physica*, Nov. 1955, Vol. 21, No. 11, pp. 867–876. In French.)

GENERAL PHYSICS

53.081.4 **1665**

Use of Logarithmic Notation in Science and Engineering.—S. Devons. (*Nature, Lond.*, 25th Feb. 1956, Vol. 177, No. 4504, pp. 373–374.) A unit for general logarithmic systems is proposed, termed the 'jot'; the notation used is: $x = (\text{unit} + xyz,ab)$ jot, but the word 'jot' is normally omitted. Advantages of the

system are simplicity of calculation, economy of notation, simplification of units, and simplification of representation of errors. Examples of use of the notation are given.

535.1 **1666**

Correlation between Photons in Two Coherent Beams of Light.—R. H. Brown & R. Q. Twiss. (*Nature, Lond.*, 7th Jan. 1956, Vol. 177, No. 4497, pp. 27–29.) Principles used in the radio interferometer described previously (103 of 1955) are applicable to the measurement of the angular diameter of visual stars if the two aerials are replaced by mirrors and the r.f. detectors by photocells. For operation of such a system it is essential that the time of arrival of photons at the two photocathodes should be correlated when the light beams incident on the two mirrors are coherent; a laboratory experiment demonstrating the existence of this effect is described.

535.13 **1667**

Asymptotic Solutions of Maxwell's Equations involving Fractional Powers of the Frequency.—M. Kline. (*Commun. pure appl. Math.*, Nov. 1955, Vol. 8, No. 4, pp. 595–614.) The principal theorem derived indicates the method of obtaining steady-state solutions, provided that the behaviour of the corresponding pulse solutions in the neighbourhood of the singularities is known.

535.231 : 536.7 **1668**

Mathematical Study of Boltzmann's Equation.—S. Marquet. (*C. R. Acad. Sci., Paris*, 30th Jan. 1956, Vol. 242, No. 5, pp. 615–617.)

535.42 : 538.566 **1669**

Diffraction by a Plane Aperture with Variable Contour. General Formulae.—O. Costa de Beauregard. (*C. R. Acad. Sci., Paris*, 16th Jan. 1956, Vol. 242, No. 3, pp. 347–350.) Four-dimensional extension of the formulae of classical diffraction theory [2909 of 1954 (Bouwkamp)].

537.211 **1670**

Some Theoretical and Practical Considerations of the Johnsen-Rahbek Effect.—A. D. Stuckes. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 125–131.) The Johnsen-Rahbek effect which is observed when a voltage is applied between metal and semiconductor surfaces in 'contact' with one another is explained as due to the e.s. force across the gap, which exists at all points except a few where contact is actually made. The force increases with the voltage until the latter reaches the critical value causing field emission. Experiments with a clutch based on this effect are described; the results indicate that such a device would be too unreliable for practical purposes; the effect might be used in relays and gas-flow valves.

537.226 **1671**

Dielectric Properties of a Lattice of Anisotropic Particles.—Z. A. Kaprielian. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 24–32.) Analysis is presented for a uniform lattice of similarly oriented particles of arbitrary shape and material. The packing density is assumed to be such that interaction between particles must be considered but the induced fields can still be regarded as simple dipole fields. Two particular cases are examined: (*a*) a cubic array of ferrite spheres, and (*b*) a tetragonal array of disks; in the latter case the calculated values of dielectric constant are in good agreement with experimental results reported by [El-] Kharadly & Jackson (2902 of 1953).

537.311.31 : 535.215 **1672**

Electronic Interaction between Adsorbed Gas Molecules and Metal Surfaces.—R. Suhrmann. (*Z. Metallkde*, Nov. 1955, Vol. 46, No. 11, pp. 780–786.) The interaction is discussed in terms of the structure of the gas molecules and the work function of the metal. Experimental investigations based on the variation of photoelectric sensitivity and resistance of thin films of the metal on adsorption of the gas are described. Metals used were Ni and Pt, gases were O, H, N, CO_2, N_2O, water vapour and benzene vapour. The investigation is relevant to the problem of conduction at the surface of semiconductors.

537.5 **1673**

The Diffusion of Electrons in a Gas at Low Temperatures.—B. I. H. Hall. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 551–554.) Laboratory measurements were made of electron agitation energy Q as a function of Z/n and Q_0, where Z is an applied electric field, n the concentration of gas molecules and Q_0 the mean agitation energy of the molecules. The gases used were N_2 and H_2.

537.52 **1674**

International Symposium on Electrical Discharges in Gases.—(*Appl. sci. Res.*, 1955, Vol. B5, Nos. 1–4, pp. 1–344.) The text is given of 66 papers presented at the symposium held at Delft in April 1955. The subjects discussed included (*a*) fundamental processes in gas discharges, (*b*) instabilities and oscillations in gas discharges, (*c*) high-frequency discharges and the dependence of breakdown on frequency and on the product of pressure and electrode separation, (*d*) methods of measurement, (*e*) arc discharges, and (*f*) spark discharges.

537.525 **1675**

Study of the Induced Electric Discharge in Rare Gases.—F. Cabannes. (*Ann. Phys., Paris*, Nov./Dec. 1955, Vol. 10, pp. 1026–1078.) Experiments were performed using a tube of a few centimetres diameter and a frequency of 1 Mc/s. Aspects investigated included the conditions for starting the discharge and the radiation from the discharge. Theory is developed giving a quantitative explanation of the experimental results. See also 2915 of 1954 and *Appl. sci. Res.*, 1955, Vol. B5, Nos. 1–4, pp. 318–320.

537.533/.534 **1676**

Penetration of Electrons and Ions in Aluminium.—J. R. Young. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 1–4.) "The depth of penetration of 0·5- to 11-keV electrons and 1- to 25-keV H^+, H_2^+, and He^+ ions in aluminium has been measured. It has been found that the Thompson-Whiddington law for electrons does not hold for electrons having energies less than 10 keV. The practical range-energy relation obtained for electrons in aluminium was found to be $R = KE^{1\cdot3}$, where K is 0·042 if E is expressed in keV and R in microns. The practical range-energy relation for light ions in aluminium was found to be $R = KE^{0\cdot83}$ where $K = 0{\cdot}020$ for H^+, $K = 0{\cdot}021$ for He^+, and $K = 0{\cdot}015$ for H_2^+ . . . Results are compared with those obtained by previous observers."

537.533 **1677**

Use of the Knife-Edge Method to determine Aberrations of Deflected Electron Beams.—H. Grümm. (*Optik, Stuttgart*, 1955, Vol. 12, No. 12, pp. 544–553.) The beam is caused to throw a shadow of a knife-edge or wire on a distant plane. Theory is given and selected shadow pictures are reproduced.

537.533.7 **1678**

Collective Oscillations and Characteristic Electron-Energy Losses.—D. Gabor. (*Phil. Mag.*, Jan. 1956, Vol. 1, No. 1, pp. 1–18.) An attempt is made to give a simple theory of the interaction of fast electrons with thin films of solids, adequate for interpreting results of past experiments and for suggesting new, crucial tests.

537.533.8: 546.45 **1679**

Secondary Electron Emission from Thin Layers of Be: Part 2.—I. M. Bronshtein & T. A. Smorodina. (*Zh. eksp. teor. Fiz.*, Oct. 1955, Vol. 29, No. 4 (10), pp. 495–499.) An experimental investigation is reported of the secondary-electron emission coefficient σ and the variation of secondary-electron energy distribution with the thickness of thin layers of Be. For approximately monatomic layers of Be on Ni or Ag and constant primary electron energy, the secondary electron energy, E_v, at which the maximum of the $d\sigma/dE_v$ versus E_v curve occurs is a minimum. Part 1: 684 of 1955.

537.533.8: 546.57 **1680**

Secondary Electron Emission from Thin Layers of Silver.—I. M. Bronshtein & T. A. Smorodina. (*Zh. eksp. teor. Fiz.*, Oct. 1955, Vol. 29, No. 4 (10), pp. 500–506.) An experimental investigation of Ag films on Ni or Be base. See also 1679 above.

537.56: 538.56: 537.311.33 **1681**

Plasma Oscillations at Extremely High Frequencies.—M. A. Lampert. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 5–11.) The analysis presented is applicable to plasmas in impurity semiconductors as well as those in gas discharges. The design of mm-λ generators based on standing waves in such plasmas is considered; electron densities of the order of $10^{15}/cm^3$ are required. In a system discussed, an electron beam is shot into the plasma, which is confined between two parallel reflecting surfaces; these may be the faces of a wafer of semiconductor whose thickness determines the natural oscillation frequency. Problems introduced by the slowing-up of the electron beam in such a system are indicated.

538.1 **1682**

Magnetic Systems associated with Systems of Permanent Electric Currents and their Application to the Numerical Calculation of Fields.—É. Durand. (*Ann. Phys., Paris*, Nov./Dec. 1955, Vol. 10, pp. 883–907.) By superposing magnetic shells associated with the elementary tubes corresponding to an arbitrary distribution of currents, the associated magnetic systems are simply determined. In this way a scalar potential inside the currents can be defined. See also 3229 of 1955.

538.1 **1683**

Derivation of an Expression for the Scalar Potential of a Line Current in the Form of a Curvilinear Integral.—É. Durand. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 78–81.)

538.13 **1684**

Calculating the Distance between Equivalent Poles of a Bar Magnet.—J. R. Boggs. (*Trans. Amer. geophys. Union*, June 1955, Vol. 36, No. 3, pp. 487–488.)

538.221 **1685**

The Barkhausen Effect.—R. S. Tebble. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1017–1032.) The only feasible mechanism to account for the phenomena associated with the Barkhausen effect is one in which the movement of a limited section of a 180° domain boundary is delayed by a nonmagnetic inclusion whose cross-sectional dimensions lie within the range $1–2 \times 10^{-5}$ cm. Hysteresis losses in ferromagnetic materials may be reduced by the selective reduction of the number of inclusions whose size is within this critical range.

538.221 **1686**

Temperature Dependence of Ferromagnetic Anisotropy in Cubic Crystals.—F. Keffer. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1692–1698.) Theories advanced by Zener and by Van Vleck are reconciled; they afford, respectively, low- and high-temperature approximations to the same physical picture, namely, an anisotropy decreasing with rising temperature, due to statistical fluctuations from alignment of anisotropically coupled neighbour spins.

538.3: 52 **1687**

A Discussion on Magneto-hydrodynamics.—(*Proc. roy. Soc. A*, 29th Dec. 1955, Vol. 233, No. 1194, pp. 289–406.) The text is given of papers presented at the discussion noted previously [3577 of 1955 (Ferraro)].

538.3: 537.56 **1688**

Some Exact Solutions of the Lorentz Invariant Problem of the Motion of Two Electric Fluids.—J. J. Gibbons. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 819–823.)

538.566: 535.42 **1689**

Some Problems on Obstacles placed in the Path of Electromagnetic Radiation.—M. Bouix. (*Ann. Télécommun.*, Nov. & Dec. 1955, Vol. 10, Nos. 11 & 12, pp. 243–251 & 254–260.) The relations between the incident, reflected and refracted fields at the surface separating two media are studied using vectorial analysis with a system of coordinates attached to the surface. Both media may be dielectrics or one may be conducting. The plane separating surface is discussed first and the analysis is extended to treat diffraction by a sphere; exact formulae are derived for the re-radiation gain and the total diffusion surface.

538.566: 535.43 **1690**

Tensor Scattering Matrix for the Electromagnetic Field.—D. S. Saxon. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1771–1775.) Theory presented previously 3105 of 1954 (Gerjuoy & Saxon) is extended to treat the vector field and to include absorption.

538.566: 537.56 **1691**

Interaction of Centimetre Waves with a Plasma in the Presence of a Magnetic Field.—F. Diamand, A. Gozzini & T. Kahan. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 90–93.) Experimental evidence of self-interaction was sought, using an a.m. wave of frequency 10 kMc/s in a circular waveguide containing a continuous discharge parallel to the direction of propagation and a transverse magnetic field. Absorption was observed, passing through a maximum at the field-strength value corresponding to the gyrofrequency. An expression for the modulation depth is derived in terms of carrier frequency, gyrofrequency and modulation frequency. The term 'self-interaction' is preferred to 'self-demodulation' since the modulation depth may be either increased or decreased, depending on the circumstances. Further experiments were made by transmitting an unmodulated 10-kMc/s

wave through a plasma oscillating at low frequency in a neon tube of length 30 cm. The r.f. wave became strongly modulated; the form of the wave envelope was modified greatly by application of a magnetic field, while the modulation disappeared completely at the field strength corresponding to gyromagnetic resonance.

538.569.4 **1692**

Absorption of Microwaves and U.H.F. Radio Waves in Phenol, Cyclohexanol and 1-Bromo 2-Chloroethane.—D. K. Ghosh. (*Indian J. Phys.*, April 1955, Vol. 29, No. 4, pp. 161–166.)

538.569.4 : 535.33 : 546.171.1 **1693**

New Method for the Observation of Hyperfine Structure of NH_3 in a 'Maser' Oscillator.—K. Shimoda & T. C. Wang. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, pp. 1148–1149.)

538.569.4 : 539.15 **1694**

Nuclear Magnetic Resonance in Very Weak Fields.—(*Helv. phys. Acta*, 15th Dec. 1955, Vol. 28, No. 7, pp. 617–632. In French.)

Part 1—A Radio Spectroscope for Observation of Resonance between 15 and 2 kc/s.—C. Manus, G. Béné, R. Extermann & R. Mercier (pp. 617–625). The apparatus is described in detail. The signal/noise ratio is calculated and the result compared with values obtained experimentally.

Part 2—Study of Nuclear Magnetic Resonance between 2 and 0·5 Gauss.—B. Cagnac, C. Manus, G. Béné & R. Extermann (pp. 626–632). Proton-resonance experiments are described. Variation of resonance curves with h.f. amplitude and with the characteristics of the scanning field is investigated.

538.569.4 : 621.376.23 **1695**

Theory of the Autodyne Detector for Paramagnetic Resonance.—F. Bruin & F. M. Schimmel. (*Physica*, Nov. 1955, Vol. 21, No. 11, pp. 867–876. In French.)

538.569.4.029.6 : 621.372.413 **1696**

Observation of Nuclear Quadrupole Resonances with a Coaxial-Cavity Spectrometer.—S. Kojima, A. Shimauchi, S. Hagiwara & Y. Abe. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 930–933.) A note on the construction of a spectrometer based on a two-cavity klystron oscillator, and its operation in the range 700 Mc/s–1 kMc/s.

538.691 **1697**

The Stability of the Equilibrium Configuration of a Current-Carrying Wire in a Magnetic Field.—C. Bernardini. (*R. C. Accad. naz. Lincei*, Nov. 1955, Vol. 19, No. 5, pp. 297–301.) The problem is considered in relation to the investigation of the trajectories of charged particles by the floating-wire method, as discussed by Loeb (78 of 1947). Analysis shows that in certain cases when the field has focusing properties the configuration of the wire is unstable. Application of the results to a betatron problem is briefly indicated.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

52 : 538.3 **1698**

A Discussion on Magneto-hydrodynamics.—(See 1687.)

523 : 538.69 **1699**

Interplanetary Magnetic Fields and Cosmic Rays.—L. Davis, Jr. (*Phys. Rev.*, 1st Dec. 1955, Vol. 100, No. 5, pp. 1440–1444.) A discussion of the implications of the hypothesis that, as a result of solar corpuscular emission, a field-free region is produced round the sun, with a mean radius of the order of 200 times the distance between the sun and the earth.

523.16 **1700**

The Measurement of the Angular Diameter of Two Intense Radio Sources.—R. C. Jennison & M. K. Das Gupta. (*Phil. Mag.*, Jan. 1956, Vol. 1, No. 1, pp. 55–75.) An interferometer using post-detector correlation is described and results of measurements of the diameter and structure of the radio stars Cygnus A and Cassiopeia A are given. The interferometer operates on 116·5, 125 or 132·5 Mc/s and uses aerials spaced at up to 12 km, the remote aerial being connected via an 83-Mc/s radio link to the correlator.

523.16 **1701**

Apparent Intensity Variations of the Radio Source Hydra-A.—O. B. Slee. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 498–507.) Over a period of 12 months about 200 observations of the intensity of Hydra-A were compared with observations on other strong r.f. sources. The results indicate that Hydra-A is relatively much more variable, though no periodic changes have been detected. Possible mechanisms producing the intensity changes are considered.

523.16 **1702**

Rotation and other Motions of the Magellanic Clouds from Radio Observations.—F. J. Kerr & G. de Vaucouleurs. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 508–522.) The motions have been studied by means of 21-cm-λ line radiation from interstellar hydrogen.

523.16 **1703**

The Angular Size of the Variable Radio Source Hydra-A.—A. W. L. Carter. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 564–567.) Preliminary observations on 101 Mc/s suggest that the size as well as the intensity of this source varies. See also 1701 above.

523.72 + 523.32] : 538.56.029.6 **1704**

Observations of Solar and Lunar Radiation at 1·5 Millimeters.—W. M. Sinton. (*J. opt. Soc. Amer.*, Nov. 1955, Vol. 45, No. 11, pp. 975–979.) Further observations have been made using the method described previously (3076 of 1952). Measured values of atmospheric absorption are greater than values of water-vapour absorption calculated by Van Vleck (3100 of 1947). The transmittances of some materials at 1·5 mm are tabulated.

523.72 : 551.593.5 **1705**

Investigation of Sky Brightness in the Spectral Region near 1 μ during the Solar Eclipse of 30th June 1954.—S. F. Rodionov & E. D. Sholokhova. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1955, Vol. 105, No. 4, pp. 676–679. In Russian.) The variation of the atmospheric infrared radiation excited by the incident solar ultraviolet radiation was investigated. Intensity variations observed at wavelengths of 1 μ and 0·71 μ indicate that the radiation from the corona is richer in ultraviolet than the radiation from the sun as a whole.

523.72 : 621.396.822 **1706**

The Distribution of Radio Brightness over the Solar Disk at a Wavelength of 21 Centimetres: Part 3—The Quiet Sun—Two-Dimensional Observations.—W. N. Christiansen & J. A. Warburton.

(*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 474–486.) The observations reported in Part 2 (715 of 1954) are extended by using two multiple interferometers arranged at right angles, thus enabling the solar disk to be scanned in many different directions. From the data thus obtained the two-dimensional brightness distribution is reconstructed by a Fourier-analysis method. Marked limb-brightening in the equatorial zones is indicated, but none in the polar regions.

523.72: 621.396.822 **1707**

Solar Brightness Distribution at a Wavelength of 60 Centimetres: Part 1—The Quiet Sun.—G. Swarup & R. Parthasarathy. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 487–497.) Observations were made with a 32-element interferometer to check Stanier's results (1401 of 1950) obtained with a two-aerial interferometer. The observed limb-brightening is reasonably consistent with that reported by O'Brien & Tandberg-Hanssen (2607 of 1955), whereas Stanier found no limb-brightening. The divergences may be related to actual differences consequent on the changing phase of the solar cycle.

550.385: 523.7: 523.165 **1708**

Correlation among Magnetic Storms, Solar Phenomena and Cosmic-Ray Storms.—Y. Sekido, M. Wada, I. Kondoh & K. Kawabata. (*Rep. Ionosphere Res. Japan*, Sept. 1955, Vol. 9, No. 3, pp. 174–180.)

551.510.535 **1709**

Movements in the Ionosphere.—J. A. Ratcliffe. (*Nature, Lond.*, 18th Feb. 1956, Vol. 177, No. 4503, pp. 307–308.) Report of Royal Astronomical Society discussion held in November 1955. Methods of measuring the movements and results obtained are briefly indicated. An important piéce of new information about the lower F region is that simultaneous observations on large-scale ripples and on the small-scale irregularities producing fading show that these two types of irregularity travel with the same speed.

551.510.535 **1710**

Movement of Sporadic-E Ionization.—J. A. Harvey. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 523–534.) "The horizontal movement of patches of daytime sporadic E ionization has been observed by using a system of spaced pulse transmitters and a central recorder. The directions of movement are mainly towards the north and west, with speeds mainly between 40 and 80 m/sec. These velocities differ in direction from the F region disturbances recorded at the same time and have only about half the speed."

551.510.535 **1711**

Electronic Collisional Frequency in the F-Region over Calcutta.—S. Datta. (*Indian J. Phys.*, June 1955, Vol. 29, No. 6, pp. 279–284.) Determinations of the collision frequency were made on the basis of Appleton's formula relating ionosphere reflection coefficient with the difference between the group and optical wave paths within the region. Values corresponding to different heights in the F layer are tabulated. The 'most probable' value is $3{\cdot}8 \times 10^3$ per sec per electron.

551.510.535 **1712**

On the Influence of Electron-Ion Diffusion on the Electron Density and Height of the Nocturnal F_2 Layer (Supplement).—T. Yonezawa. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 281–291.) The influence of the earth's magnetic field on electron-ion diffusion will tend to reduce the atmospheric density in the F_2 region at night; a lower limit for the maximum density of 3×10^5 cm^{-3}, or 60% of the value suggested in the earlier paper (751 of March), is possible. Other considerations tend to confirm the value of 5×10^5 cm^{-3} originally suggested, which agrees with extrapolations from rocket data if the true height of the F_2 layer is about 200 km.

551.510.535 **1713**

On the Occurrence of Spread Echoes in the F Region over Japan.—I. Kasuya, S. Katano & S. Taguchi. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 329–339.) Analysis of published ionospheric data for Japan for the period 1949–1954 suggests that spread echoes occur more frequently in the north than in the south, chiefly at night, at the solstices and when solar activity is weak. Echoes of the most common type are attributed to reflections from irregularities in the upper regions of the F layer which are normally masked in daytime; others may be due to reflections from turbulences during magnetic storms, or to ionized clouds passing through the normal layer.

551.510.535 **1714**

Photoelectric Studies of the Night Sky Light: Part 4.—M. Huruhata, H. Tanabe & T. Nakamura. (*Rep. Ionosphere Res. Japan*, Sept. 1955, Vol. 9, No. 3, pp. 136–147.) An attempt is made to correlate variations of night-glow intensity with those of electron density in the F_2 layer; the results are inconclusive.

551.510.535: 001.4 **1715**

Russian Ionosphere Terminology.—G. F. Schultz. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, p. 376.) Russian equivalents are given for about 30 English terms.

551.510.535: 523.78: 550.385 **1716**

Effect of the Solar Eclipse on the Lower Parts of the Ionosphere and the Geomagnetic Field.—T. Nagata, Y. Nakata, T. Rikitake & I. Yokoyama. (*Rep. Ionosphere Res. Japan*, Sept. 1955, Vol. 9, No. 3, pp. 121–135.) Changes in E-layer electron density observed at a number of stations during the solar eclipse of 9th May 1948 have been examined and the resulting changes in conductivity deduced. The effects are found to exist over a very much wider area than that eclipsed. The calculated modifications in the S_q current consequent upon the electron-density changes provide a satisfactory quantitative explanation of changes in the earth's magnetic field at the time of the eclipse.

551.510.535: 525.624 **1717**

Lunar Tide in Sporadic E at Brisbane.—J. A. Thomas & A. C. Svenson. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 554–556.) An analysis has been made of night-time values of $h'E_s$ for the period December 1952–November 1953; results are tabulated and plotted on a 12-hour harmonic dial. The semidiurnal variation has a mean amplitude of 0·69 km and a mean phase of 6·7 h. Results are compared with those of Martyn (1052 of 1949) and Matsushita (408 of 1954).

551.510.535: 550.385 **1718**

The Electrical Conductivity of the Ionosphere and Disturbances of the Geomagnetic Field at Audio and Lower Frequencies.—G. Grenet. (*C. R. Acad. Sci., Paris*, 16th Jan. 1956, Vol. 242, No. 3, pp. 401–403.) On the basis of assumed values for collision frequency and maximum electron density for the E, F_1 and F_2 layers, values are calculated for the conductivity parallel and perpendicular to the magnetic field, and for periods corresponding to certain critical frequencies.

The significance of the results is discussed in relation to the possibility of extraterrestrial origins for geomagnetic-field disturbances.

551.510.535 : 550.385 **1719**

Daily Variations of the Electrical Conductivity of the Upper Atmosphere as deduced from the Daily Variations of Geomagnetism: Part 1—Equatorial Zone.—H. Maeda. (*Rep. Ionosphere Res. Japan*, Sept. 1955, Vol. 9, No. 3, pp. 148–165.)

551.510.535 : 550.385 **1720**

Studies on the Disturbances in F₂ Layer associated with Geomagnetic Disturbances.—K. Sinno. (*Rep. Ionosphere Res. Japan*, Sept. 1955, Vol. 9, No. 3, pp. 166–173.) Reports on work published previously (3303 of 1953 and 3258 of 1955) are collected and discussed.

551.510.535 : 621.396.11 **1721**

Radio Observations of the Ionosphere at Oblique Incidence.—Chapman, Davies & Littlewood. (See 1850.)

551.594.5 **1722**

Preliminary Studies of the Distribution of Auroras in Alaska.—C. T. Elvey, H. Leinbach, J. Hessler & J. Noxon. (*Trans. Amer. geophys. Union*, June 1955, Vol. 36, No. 3, pp. 390–394.) "The analysis of auroral observations for 1951–53 from five stations spread over Alaska shows a zone at geomagnetic latitude 68° for which the incidence of auroras is independent of magnetic activity. At geomagnetic latitudes south of 67°, the incidence of auroras is markedly dependent upon magnetic activity."

551.594.5 **1723**

Auroral Heights over West-Central Canada.—B. W. Currie. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 773–779.) Results of an analysis of parallactic photographs of aurorae taken in 1933 at Chesterfield (63·3°N, 90·7°W) suggest that auroral heights in this region are slightly greater than those observed from Norway. There is no definite evidence of a change of height with time after sunset.

551.594.6 **1724**

Observations of Whistling Atmospherics at Geomagnetically Conjugate Points.—M. G. Morgan, H. E. Dinger & G. McK. Allcock. (*Nature, Lond.*, 7th Jan. 1956, Vol. 177, No. 4497, pp. 29–31.) Comparison of records obtained at points in N. America and in New Zealand appear to confirm Storey's theory (142 of 1954) that 'whistlers' and 'swishes' are produced as the atmospherics travel along the dispersive paths constituted by the geomagnetic flux lines between the northern and southern hemispheres.

LOCATION AND AIDS TO NAVIGATION

621.396.93 : 621.396.677.51 : 621.318.134 **1725**

Ferrite Aerials in Goniometer Direction Finders.—Ziehm. (See 1622.)

621.396.96 + 621.396.93 **1726**

Symposium on Marine Communications and Navigation.—(*Trans. Inst. Radio Engrs*, March 1955, Vol. CS-3, No. 1, pp. 1–72.) The full text is given of 24 papers presented at the symposium held at Boston, Mass., in October 1954. The subjects discussed included electronic aids to the fishing industry, and the need for further developments and supplementary techniques in radar.

621.396.96 **1727**

A Radar System for Harbour Surveillance.—A. Leconte. (*Onde élect.*, Dec. 1955, Vol. 35, No. 345, pp. 1147–1152.) Shore-based radar systems for harbour control are discussed and the installation at Dunkirk is described; the frequency used is between 9·345 and 9·410 kMc/s. Identification of ships by means of transponder beacons, either permanently installed or carried to the ship by the pilot, is suggested.

621.396.96 **1728**

Radar Warning Net uses Centralized Control.—J. L. Lombardo. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 168–170.) Description of the SAGE (semi-automatic ground environment) system, which does not depend on voice communication or interpretation of tracks by individual operators. Computers are used to identify unknown objects by correlating radar tracks with flight plans.

621.396.96 : 551.578.1 **1729**

A Turnstile Polarizer for Rain Cancellation.—P. A. Crandell. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. MTT-3, No. 1, pp. 10–15.)

621.396.963 : 628.972 **1730**

A Method of increasing the Ambient Illumination of Radar Operations Rooms without Reduction of Signal Detection Threshold.—C. R. Barnard. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 199–202.) A narrow-band optical filter is arranged on the face of the display c.r. tube, and the colour of the illumination is chosen to be complementary to the response of the tube

621.396.969 : 621.396.67 **1731**

Reflection of Electromagnetic Waves from Thin Metal Strips (Passive Antennae).—K. Lindroth. (*Kungl. tek. Högsk. Handl., Stockholm*, 1955, No. 91, 62 pp.) The accuracies of several previously described methods of calculating the current in the strips are compared.

621.396.969.32 **1732**

Microwave Vehicle-Speed Indicator.—G. W. G. Court. (*Wireless Engr*, March 1956, Vol. 33, No. 3, pp. 66–74.) A Doppler-radar-type instrument developed at the New Zealand Dominion Physical Laboratory uses a hybrid waveguide junction to provide both transmitting and receiving channels, so that only a single aerial is required. Leakage from the klystron oscillator used as c.w. transmitter provides local-oscillator power for the homodyne detector. Ranges of several hundred yards are obtained on small cars. An estimate of the various possible errors is included.

MATERIALS AND SUBSIDIARY TECHNIQUES

533.583 : 539.16 **1733**

Use of Krypton-85 in measuring Gas Clean-Up Rates.—D. J. Harris & P. O. Hawkins. (*Nature, Lond.*, 11th Feb. 1956, Vol. 177, No. 4502, pp. 285–286.) Techniques for monitoring the clean-up rate in pre-t.r. valves are briefly described. Radioactive krypton is more suitable than argon or xenon because of its long half-life and readily detectable radiation.

535.37 + 535.215] : 537.311.33 **1734**

Cadmium Sulfide with Silver Activator.—J. Lambe. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1586–1588.) Further experiments are reported, the results of which are consistent with the model for CdS(Ag) suggested previously [3274 of 1955 (Lambe & Klick)].

535.37 : 546.472.21 **1735**

X-Ray Powder Diffraction Data for Hexagonal Zinc Sulphide.—M. A. Short & E. G. Steward. (*Acta cryst.*, 10th Nov. 1955, Vol. 8, Part 11, pp. 733–734.)

535.376 : 546.472.21 **1736**

Electroluminescence in Disordered Zinc Sulphide.—M. A. Short, E. G. Steward & T. B. Tomlinson. (*Nature, Lond.*, 4th Feb. 1956, Vol. 177, No. 4501, pp. 240–241.) Experiments are briefly reported indicating that electroluminescence both in single crystals and in powders of Cu-activated ZnS may be associated with one-dimensional structural disorder.

537.226/.227 **1737**

Replacement of Ti in $BaTiO_3$ Ceramic by Si and Ge.—K. W. Plessner & R. West. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1150–1152.) Permittivity/temperature curves are shown for $BaTiO_3$, $Ba(Ti_{0\cdot9}Ge_{0\cdot1})O_3$ and $Ba(Ti_{0\cdot9}Si_{0\cdot1})O_3$; the principal effect of introducing the Ge and Si is to reduce the peaks at the transitions at 120° and 10°C. Values of remanent polarization, coercive field and total permittivity are tabulated.

537.226/.227 **1738**

Very-Low-Temperature Study of the Dielectric Constant of Ferroelectric Alkaline Phosphates and Arsenates.—S. Le Montagner, J. Le Bot, M. Hagene, F. Lasbleis & M. Le Page. (*C. R. Acad. Sci., Paris*, 23rd Jan. 1956, Vol. 242, No. 4, pp. 475–478.) Anomalous variations corresponding to absorption maxima in the complex-dielectric-constant/temperature curves have been observed in the region of 60°–70°K at frequencies between 100 c/s and 1 Mc/s. Variation of the coercive force may be responsible for the effect, which is observed only in the ferroelectric phosphates and arsenates, i.e. those of K, Rb and Cs.

537.226 **1739**

Dielectric Absorption in Dilute, Liquid, Polar Solutions: a New Approach.—A. Fairweather. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1038–1042.) On the assumption that energy loss in a liquid polar dielectric is related to density rather than to viscosity, the relaxation time is shown to be proportional to $(a^5\rho/kT)^{\frac{1}{2}}$, where a is the molecular radius, ρ the density, k Boltzmann's constant and T the absolute temperature.

537.226 : 621.315.612.4 : 546.431.824-31 **1740**

Dependence of the Dielectric Properties of Ceramic $BaTiO_3$ for High-Frequency Currents on the Technology of the Preparation of Samples.—M. Jeżewski & T. Piech. (*Acta phys. polon.*, 1955, Vol. 14, No. 5, pp. 395–405.) Measurements were made on a series of samples prepared by grinding, pressing and re-sintering the previously prepared sample. The dielectric constant increases significantly with the amount of processing; the losses do not vary significantly.

537.226.2/.3 : 621.317.3.029.6 **1741**

Measurements of the Dielectric Constant and Loss Angle of Building Materials.—M. Balachandran. (*Z. angew. Phys.*, Dec. 1955, Vol. 7, No. 12, pp. 588–593.) Measurements were made on brick, gypsum, cement and various wood specimens at 10 cm λ, and on oak and beech also at 8·75 and 3·2 cm λ. The effects of water absorption are shown graphically.

537.227/.228 : 546.431.824-31 **1742**

Theory of Spontaneous [ferroelectric] **Deformation of Barium Titanate.**—W. Kinase & H. Takahashi. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 942–952.)

537.227/.228.1 : 547.476.3 **1743**

Electrical After-Effects in Rochelle Salt.—K. N. Karmen. (*Zh. eksp. teor. Fiz.*, Oct. 1955, Vol. 29, No. 4 (10), pp. 533–534.) The observed changes of the charge/discharge characteristics following application of a pulsed electric field for various lengths of time are presented graphically and briefly discussed.

537.227 : [546.32.882.5 + 546.33.882.5 **1744**

A Thermodynamic Treatment of Ferroelectricity and Antiferroelectricity in Pseudo-cubic Dielectrics.—L. E. Cross. (*Phil. Mag.*, Jan. 1956, Vol. 1, No. 1, pp. 76–92.) "The Kittel-Devonshire phenomenological treatment of antiferroelectricity is extended to the case of polarizations in three dimensions in a pseudo-cubic material. There are ten possible solutions of the proposed free energy equation, corresponding to non-polar, ferroelectric, antiferroelectric and ferrielectric states, and expressions are derived for the polarization and dielectric stiffness coefficients in these forms." The theory is applied to $NaNbO_3$ and $KNbO_3$ and their solid solution $(NaK)NbO_3$.

537.227 : 546.431.824-31 **1745**

Dynamic Method for measuring the Pyroelectric Effect with Special Reference to Barium Titanate.—A. G. Chynoweth. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 78–84.) "Transient currents produced in single crystals of barium titanate when subjected to flashes of light are shown to be pyroelectric in origin. The illumination results in a small change in the temperature of the crystal which, in turn, causes the polarization to change. This change is recorded as a current in the external circuit. It is shown that from room temperature up to the Curie point, the pyroelectric current is consistent with the polarization as a function of temperature, as determined from hysteresis loop measurements. The technique proves to be a sensitive and nondestructive method for studying the state of polarization of a crystal. The technique is used to study the pyroelectric effect induced by applied static electric fields at temperatures above the Curie point. The results are consistent with Devonshire's theory of the ferroelectricity of $BaTiO_3$, and they confirm that the Curie point transition is of the first order."

537.311.33 **1746**

The Concept of the Hole in Semiconductors.—J. L. Salpeter. (*Proc. Instn Radio Engrs, Aust.*, Dec. 1955, Vol. 16, No. 12, pp. 427–442.) Use is made of the transmission-line and wave-filter analogy to explain the concept of the hole. The behaviour of semiconductors subjected to magnetic fields and mechanical forces and the thermoelectric power of semiconductors are discussed.

537.311.33 **1747**

Magnetic Susceptibility of Impurity-Trapped Electrons and Holes in Semiconductors.—E. Mooser. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1589–1592.) Calculations are made explicitly for donor impurities; similar reasoning holds for acceptors. At low temperatures there is an appreciable difference between the values of susceptibility of the electron gas with and without the impurities; this difference enables the presence of an impurity conduction band to be determined from magnetic measurements. Measurements on Si reported by Portis et al. (3342 of 1953) are interpreted in terms of the theory. A narrow donor band is found in Si containing $1{\cdot}5 \times 10^{18}$ P atoms/cm^3, in agreement with Baltensperger's predictions (1451 of 1954).

537.311.33 **1748**

Impurity Band in Semiconductors with Small Effective Mass.—F. Stern & R. M. Talley. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1638–1643.) An approximate calculation of the energy states for the 1*s* band of metallic hydrogen is carried out for lattice constants smaller than those considered by Baltensperger (1451 of 1954). A simple transformation of the distance and energy scales makes the calculation applicable to impurities in a semiconductor. Optical measurements of the energy gap in InAs as a function of impurity content are reported. The effective carrier mass required to fit published optical data for InSb is about 0·03 *m*, as compared with 0·013 *m* found by cyclotron-resonance measurements.

537.311.33 **1749**

Interaction of Impurities and Mobile Carriers in Semiconductors.—G. W. Lehman & H. M. James. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1698–1712.) A comprehensive analysis is presented. The theory differs from others in predicting a marked temperature dependence of the activation energy; this results from the temperature dependence of the polarizability of the mobile carrier distribution.

537.311.33 **1750**

A Particular Form of the Equations governing the Propagation of Free Carriers in a Homogeneous Crystal Lattice of Junction Type in a Unidimensional System.—A. Leblond. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 85–87.) Analysis is given for a semiconductor system comprising a number of parallel plane junctions. Equations permitting of solution by simple numerical integration are derived by choosing as unknown variables the numbers of free electrons and holes and the electric field strength; I/V characteristics can hence be deduced.

537.311.33 **1751**

Properties and Structures of Ternary Semiconducting Systems: Part 1.—B. T. Kolomiets & N. A. Goryunova. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 984–994.) An experimental investigation has shown that in the pseudo-binary section $m\mathrm{Tl_2Se}\ n\mathrm{Sb_2Se_3}$ of the ternary system Tl-Sb-Se there is a compound $\mathrm{Tl_2Sb_2Se_4}$ which is a typical *p*-type semiconductor. By altering the proportion of the constituents in the series $m\mathrm{Tl_2Se}.n\mathrm{Sb_2Se_3}$ it is possible to obtain a large variety of semiconductors. Replacement of Sb by As in the system gives a new group of semiconductors of amorphous structure. It is suggested that a study of ternary systems should lead to the discovery of semiconductors with new basic properties.

537.311.33 **1752**

Bipolar Diffusion in Semiconductors at Heavy Currents.—K. B. Tolpygo & I. G. Zaslavskaya. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 955–977.) A solution is given of equations describing bipolar diffusion in a semiconductor in which there is an inversion of the sign of conductivity. The forward current is considered for a plane or hemispherical contact; in addition to 'flooding' of the barrier layer by current carriers, the penetration of carriers of one sign into the region of opposite sign is of great importance. As a result, the total resistance of the system is much lower than that of a homogeneous semiconductor of the same thickness. Calculated voltage/current characteristics for forward current are plotted.

537.311.33 **1753**

Electrical Properties of the Intermetallic Compounds Mg_2Si, Mg_2Ge, Mg_2Sn and Mg_2Pb.—U. Winkler. (*Helv. phys. Acta*, 15th Dec. 1955, Vol. 28, No. 7, pp. 633–666. In German.) Polycrystalline specimens were prepared by direct co-fusion of the ingredients. Measurements of conductivity, Hall constant and thermoelectric power over the temperature range 100°–1 100°K indicate that the compounds are true semiconductors; Mg_2Pb appears to be strongly degenerate.

537.311.33: 535.215: 546.289 **1754**

Negative Photoeffects in Semiconductors.—F. Stöckmann. (*Z. Phys.*, 12th Dec. 1955, Vol. 143, No. 3, pp. 348–356.) The observed decrease of conductivity on illuminating a Ge specimen which had previously been bombarded by fast electrons is discussed. This effect is due to the removal of minority carriers from impurity centres and their recombination with the majority carriers. The effect occurs most easily in semiconductors with doubly charged impurities in the lattice. A full account of the investigation is to be published in *Phys. Rev.*

537.311.33: 536.2 **1755**

A New Method of measuring the Thermal Characteristics of Semiconductors.—M. A. Chernyakova & A. F. Chudnovski. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1013–1018.) A single arrangement, based on a bridge circuit, is used to determine electrical conductivity σ, thermal conductivity λ, volume thermal capacity C, thermometric conductivity λ/C and thermal admittance $\sqrt{\lambda C}$. The method is based on certain regularities of a nonstationary temperature field during the cooling (or heating) of a body; it is particularly convenient for obtaining thermal characteristics of thermistors.

537.311.33: 538.63 **1756**

Experimental Investigation of Transverse Nernst-Ettingshausen Effect in Tellurium.—I. V. Mochan. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1003–1012.)

537.311.33: 538.632 **1757**

Theory of Hall Effect in Ionic Semiconductors.—M. I. Klinger. (*Zh. eksp. teor. Fiz.*, Oct. 1955, Vol. 29, No. 4 (10), pp. 439–448.) The Hall constant of ionic semiconductors is calculated using the method of steady states. The interaction between an electron and the polarization oscillations of the crystal is considered in the adiabatic and the weak-coupling approximations.

537.311.33: [546.28 + 546.289 **1758**

A Mathematical Analysis of Solute Redistribution during Solidification.—V. G. Smith, W. A. Tiller & J. W. Rutter. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 723–745.) It is shown and experimentally verified that *p-n* junctions may be produced during solidification in Ge and Si melts containing two suitable solutes, e.g. Ga and Sb in Ge.

537.311.33: [546.28 + 546.289 **1759**

Statistics and Galvanomagnetic Effects in Germanium and Silicon with Warped Energy Surfaces.—B. Lax & J. G. Mavroides. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1650–1657.) Calculations based on the Boltzmann transport theory are applied to the warped energy surfaces which have been determined by cyclotron-resonance experiments. Expressions are derived for the hole densities, conductivity, effective carrier masses, intrinsic carrier concentration and Hall coefficient as a series expansion in terms of the anisotropy parameters of the warped surfaces.

537.311.33: 546.28 **1760**

Exchange Effects in Spin Resonance of Impurity Atoms in Silicon.—G. Feher, R. C. Fletcher & E. A. Gere. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1784–1786.) Observations lending support to Slichter's theory (151 of January) are reported.

537.311.33: 546.289 **1761**

Observations of Dislocations along Grain Boundaries in Germanium Crystals.—J. Okada. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 1018–1019).

537.311.33: 546.289 **1762**

On the Coupled Dislocations along a Grain Boundary.—Y. Uemura. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 1020–1022.) Theoretical calculations are presented relevant to the observations of Okada (1761 above) and Oberly (745 of 1955).

537.311.33: 546.289 **1763**

Amphoteric Impurity Action in Germanium.—W. C. Dunlap, Jr. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1629–1633.) Impurities capable of acting either as donors or acceptors are discussed, gold being taken as an example; the effect depends on the presence of other impurities. The existence of a donor level at 0·05 eV above the valance band as well as two acceptor levels at 0·15 and 0·55 eV is confirmed.

537.311.33: 546.289 **1764**

Carrier Capture Probabilities in Nickel-Doped Germanium.—J. F. Battey & R. M. Baum. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1634–1637.) "Nickel has been diffused into germanium in order to study the carrier capture probabilities of the two nickel acceptor levels. Measurements of minority carrier lifetime as a function of temperature show that the electron capture probability of low-resistivity *p*-type samples is temperature-independent. The electron capture probability of high-resistivity *p*-type samples increases exponentially with increasing temperature, as does the hole capture probability of high-resistivity *n*-type samples. Possible interpretations of the results are discussed."

537.311.33: 546.289 **1765**

Thermal Acceptors in Vacuum Heat-Treated Germanium.—R. L. Hopkins & E. N. Clarke. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1786–1787.) An experiment is described which indicates that very few acceptor centres are introduced into Cu-free Ge by quenching from high temperatures provided care is taken to maintain the Ge surface free from impurities.

537.311.33: 546.289 **1766**

Investigations of Surface Recombination Velocities on Germanium by the Photoelectromagnetic Method.—T. M. Buck & W. H. Brattain. (*J. electrochem. Soc.*, Nov. 1955, Vol. 102, No. 11, pp. 636–640.) Ge specimens subjected to various surface treatments and to temperatures between 65° and 100°C were investigated using technique described by Moss et al. (748 of 1954). Results indicate that the method does not permit accurate calculation of surface recombination velocity.

537.311.33: 546.289 **1767**

Surface States on Germanium.—J. Lees & S. Walton. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1152–1153.) *I/V* characteristics of W contacts on *p*- and *n*-type Ge specimens with a range of resistivities are presented. The results are in agreement with Bardeen's surface-states theory (*Phys. Rev.*, 15th May 1947, Vol. 71, No. 10, pp. 717–727).

537.311.33: 546.289 **1768**

Modulation of the Surface Conductance of Germanium by Pulsed Electric Fields.—G. G. E. Low. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1154–1157.) The effect found previously (2007 of 1955), that the free surface of *n*-type Ge is positive with respect to the bulk of the material in the presence of a pulsed negative field, is confirmed; it is explained as a capacitance effect resulting from the action of surface traps.

537.311.33: 546.561-31 **1769**

Exciton Absorption in Cuprous Oxide.—J. H. Apfel & L. N. Hadley. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1689–1691.)

537.311.33: 546.681.86 **1770**

Fast-Neutron Bombardment of GaSb.—J. W. Cleland & J. H. Crawford, Jr. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1614–1618.) Experimental results indicate that the charge-carrier concentration and mobility of *n*- and *p*-type GaSb decrease as a consequence of neutron bombardment. Effects obtainable by heat treatment subsequent to the bombardment are discussed.

537.311.33: 546.682.19 **1771**

Pressure Dependence of the Resistivity, Hall Coefficient, and Energy Gap for InAs.—J. H. Taylor. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1593–1595.) Measurements have been made at pressures from 1 to 2 000 atm. Both resistivity and Hall constant increase exponentially over the range, the total resistivity increase being 19% and the total Hall-constant increase being 12% at 201°C. The pressure coefficient of energy gap is deduced from the resistivity variation to be $8{\cdot}8 \times 10^{-6}$ eV/atm, and from the Hall-constant variation to be $5{\cdot}5 \times 10^{-6}$ eV/atm; the latter value is considered the more accurate.

537.311.33: 546.682.86 **1772**

Hall Effect and Conductivity of InSb.—H. J. Hrostowski, F. J. Morin, T. H. Geballe & G. H. Wheatley. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1672–1676.) The conductivity and Hall coefficient of high-purity single-crystal specimens of InSb have been measured over the temperature range 1·3°–700°K; semiconductor properties of the material are deduced.

537.311.33: 546.682.86 **1773**

The Lifetime of Added Carriers in InSb.—I. M. Mackintosh & J. W. Allen (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 985–990.) Experimental optical-absorption curves of *n*-type and *p*-type samples of InSb are analysed on the basis of the Roosbroeck-Shockley theory of radiative recombination (3258 of 1954), allowance being made for degeneracy. A decay time of 0·75 μs is indicated for a small disturbance in carrier concentration. The results suggest that the radiative process may be the predominant recombination mechanism in this material.

537.311.33: 546.682.86 **1774**

Melting Patterns appearing on Single Crystals of InSb.—M. F. Millea & C. T. Tomizuka. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 96–97.)

537.311.33: 669.046.54 **1775**

Electromagnetic Suspension of a Molten Zone.—W. G. Pfann & D. W. Hagelbarger. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 12–18.) A zone-melting method requiring no container is described. A rod of

the material is held horizontally, clamped at both ends, and a direct current is passed through it. At the region where melting is to be effected a horizontal magnetic field is applied normal to the rod. The resulting vertical force on the rod balances the gravitational pull. Various applications are indicated, including the production of semiconductor junctions by the remelt or the rate-growing process.

537.311.62 : 546.811 **1776**

Surface Resistance of Tin in Superconducting State at a Frequency of 7·3 × 10^{10} c/s.—P. A. Bezuglyi, A. A. Galkin & G. Ya. Levin. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1955, Vol. 105, No. 4, pp. 683–684. In Russian.)

537.312.8 : 538.639 : 546.3-1-74-72 **1777**

Electrical Resistance of Iron-Nickel Alloys at Low Temperatures (14°–90°K) and its Change in a Strong Magnetic Field.—E. Kondorski & I. Ozhigov. (*C. R. Acad. Sci. U.R.S.S.*, 21st Dec. 1955, Vol. 105, No. 6, pp. 1200–1203. In Russian.) An experimental investigation of alloys containing between 40% and 100% Ni. The effect of heat treatment was also investigated. Results are presented graphically.

537.533 : 537.311.33 **1778**

Electron Bombardment Effects in Thin Dielectric Layers.—W. E. Spear. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 991–1000.) An investigation of primary- and secondary-electron currents is described for layers between 0·7 and 5 μ thick, of mica, pyrex, As_2S_3 and Sb_2S_3, using bombarding electron energies up to 50 keV and, in the case of mica, with fields up to 10^6 V/cm across the specimen. The values of primary and secondary currents for specimens of different thickness and material fall on common curves when plotted against a suitable independent variable. The secondary-current curves are interpreted in terms of the displacement of charge carriers in the space-charge field within the dielectric.

538.1 : 538.221 **1779**

Theory of Atomic Magnetic Moments in Ferromagnetic Materials.—N. S. Akulov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Dec. 1955, Vol. 105, No. 5, pp. 935–938. In Russian.) Simple formulae are derived for elements and alloys, on the basis of the zone theory.

538.221 **1780**

Ferromagnetic Domains in Permanent Magnet Materials.—L. F. Bates. (*Research, Lond.*, Dec. 1955, Vol. 8, No. 12, pp. 462–472.) A general account is given of the domain concept and its application to ferromagnetic metals. Quantitative tests of contemporary theories by means of powder-pattern technique are described. Photographs and diagrams of powder patterns on alnico, columnar alcomax and other materials are reproduced.

538.221 **1781**

Technical Properties of Iron Powder Magnets.—E. H. Carman. (*Brit. J. appl. Phys.*, Dec. 1955, Vol. 6, No. 12, pp. 426–429.) The coercive force, remanence and maximum energy product of compacts of iron prepared by hydrogen reduction of ferric oxide were measured as functions of the density of packing and the particle size. The results are presented graphically. The presence of a small percentage of oxide does not appreciably affect the quality of the magnets.

538.221 **1782**

Influence of Magnetic Field on the Precipitation Process of Ferromagnetic Phase in Cu-Co Alloy.—T. Mitui & S. Miyahara. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 1023–1024.)

538.221 : 534.121.1 **1783**

[Mechanical] **Damping in Iron-Nickel Alloys.**—R. Ochsenfeld. (*Z. Phys.*, 12th Dec. 1955, Vol. 143, No. 3, pp. 357–373.) Apparatus for measuring the damping of flexural vibrations of the alloy strips is described. The vibrations, produced magnetically, were at frequencies between 200 and 1 300 c/s. Results of measurements are discussed and compared with theoretical results; the contributions from magnetic and magnetomechanical hysteresis and from macroscopic and microscopic eddy currents are identified.

538.221 : 538.632 **1784**

Hall Effect, Spontaneous Magnetization and Temperature.—E. A. Ascher. (*Helv. phys. Acta*, 15th Dec. 1955, Vol. 28, No. 7, pp. 667–693. In French, with English summary.) Hall effect in ferromagnetic materials is studied on the basis of theory of spontaneous effects; a law is derived relating the spontaneous Hall effect to the spontaneous magnetization at a given temperature. Irreversible Fe-Ni alloys are used to permit the spontaneous magnetization to be varied without changing the temperature of the sample. See also 2337 of 1955 (Perrier & Ascher).

538.221 : 538.65 **1785**

The Magneto-elastic Properties of some Ferromagnetic Iron-Nickel Alloys.—R. Ochsenfeld. (*Z. Phys.*, 22nd Dec. 1955, Vol. 143, No. 4, pp. 375–391.) An investigation of changes in elastic modulus with magnetization (ΔE effect) and with amplitude of vibration (δE effect) for 36% and 60% Ni strips. See also 1783 above.

538.221 : 538.652 : 546.74 **1786**

Residual Magnetization and Magnetostriction of Nickel Single Crystals.—Y. Nakamura. (*J. phys. Soc. Japan*, Nov. 1955, Vol. 10, No. 11, pp. 937–941.) A report of measurements made on long cylindrical crystals at room temperature.

538.221 : 546.666 **1787**

Magnetic Properties of Erbium Metal.—J. F. Elliott, S. Legvold & F. H. Spedding. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1595–1596.) Measurements indicate that the material becomes ferromagnetic at a temperature near 20°K.

538.221 : 621.318.124 **1788**

Mechanism by which Cobalt Ferrite heat-treats in a Magnetic Field.—H. J. Williams, R. D. Heidenreich & E. A. Nesbitt. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 85–89.) Magnetic torque measurements and electron-diffraction observations on several Co and CoZn ferrites, interpreted in the light of previous work on Fe_2NiAl and alnico 5 [see e.g. 172 of 1955 (Nesbitt et al.)], show that correlation between torque reversals and response to heat treatment in a magnetic field indicates the presence of fine precipitated particles of a second phase in the composition of the material.

538.221 : 621.318.134 **1789**

Paramagnetism of some Rare-Earth Ferrites.—J. C. Barbier & R. Aléonard. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 83–85.) Continuation of the investigation reported by Benoit (3319 of 1955).

538.221 : 621.318.134 **1790**

Structure of Rare-Earth Ferrimagnetic Ferrites.—F. Bertaut & F. Forrat. (*C. R. Acad. Sci., Paris*, 16th Jan. 1956, Vol. 242, No. 3, pp. 382–384.) Discussion indicates that the spontaneous magnetization exhibited by these ferrites could not result from a

perovskite structure but is consistent with a composition $Fe_5B_9O_{19}$ (B representing the rare earth) having the two-sublattice structure proposed by Néel (3275 of 1954).

538.221 : 621.318.134 : 538.569.4 **1791**

Ferromagnetic Resonance in Manganese Ferrite Single Crystals.—P. E. Tannenwald. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1713–1719.) Two types of Mn ferrite were investigated at temperatures ranging from 4·2° to 300°K, using frequencies of 24, 9·1, 5·6, and 2·8 kMc/s. Resonance lines as narrow as 47 oersted were obtained; the width depends on crystal orientation, temperature and frequency. The anisotropy does not depend on frequency but increases rapidly at low temperature. Double resonances have been observed.

538.221 : 621.318.134 : 538.614 **1792**

Study of Magnetic Rotatory Polarization in Copper Ferrite at 10 kMc/s.—F. Mayer. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 81–83.) Measurements of the Faraday rotation are used to study the different properties of the cubic and quadratic crystal forms of Cu ferrite. The polarization-rotation-angle/magnetic-field characteristics are loops resembling the usual magnetization curves. Losses on introducing the two specimens in a waveguide are field-independent for the cubic form. Investigations of the polarization ellipticity indicate that the cubic form produces selective absorption.

538.221 : 621.385.833 **1793**

Depiction of Domains of a Ferromagnetic Material by an Electron-Optical Method.—G. V. Spivak, N. G. Kanavina, I. S. Sbitnikova & T. N. Dombrovskaya. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1955, Vol. 105, No. 4, pp. 706–708. In Russian.) Photographs of images (× 50) obtained by the secondary-emission-microscope method [2739 of 1954 (Spivak et al.)] and by the powder-pattern method are compared.

538.221 : 621.385.833 **1794**

Magnetic Contrast in Electronic Mirrors and Observation of Domains in a Ferromagnetic Material.—G. V. Spivak, I. N. Prilezhaeva & V. K. Azovtsev. (*C. R. Acad. Sci. U.R.S.S.*, 11th Dec. 1955, Vol. 105, No. 5, pp. 965–967. In Russian.) Further development of earlier work (1793 above) is reported. Microphotographs (× 150) of electron-optical images of domain structures are shown.

538.569.3 : 621.372.56.029.63/.64 **1795**

R.F. Attenuators and Load Materials.—Lichtman. (See 1647.)

546.3-1 : 541.57 **1796**

Covalent Alloys among the Intermetallic Compounds. The Compounds PrGe and CaGe.—A. Iandelli. (*R. C. Accad. naz. Lincei*, Nov. 1955, Vol. 19, No. 5, pp. 307–313.)

621.319.2 **1797**

The Mechanism of some Electrets.—K. Antenen. (*Z. angew. Math. Phys.*, 25th Nov. 1955, Vol. 6, No. 6, pp. 478–484.) Measurements were made on carnauba-wax disks with thin silver electrodes on the faces and potential probes sealed at points round the circumference. The potential distribution through the disk was determined at temperatures of 35°, 50° and 70°C. Charging and discharge currents exhibited the expected time variation. The results indicate that the electret effect in carnauba wax is due to the low conductivity of ions in the electric field.

MATHEMATICS

517 **1798**

Laplace Transformation.—H. Goldenberg. (*Elect. Rev., Lond.*, 23rd Dec. 1955, Vol. 157, No. 26, pp. 1223–1224.) An elementary explanation of the Laplace transformation is given and illustrated by examples. The use of tables of Laplace transforms to find Heaviside pairs not easily obtainable by Heaviside calculus is demonstrated.

517 : 512.831 **1799**

The Solution of Linear Simultaneous Equations by Matrix Iteration.—J. Guest. (*Aust. J. Phys.*, Dec. 1955, Vol. 8, No. 4, pp. 425–439.)

517.43 **1800**

Mikusiński's Operational Calculus.—V. Dolezal & J. Kurzweil. (*Slab. Obz., Prague*, Nov. 1955, Vol. 16, No. 11, pp. 582–592.) An introductory article which includes the fundamental theory of the calculus, its relation to the Laplace transform and examples of its applications in circuit theory and the solution of ordinary differential equations with constant coefficients. The calculus is applicable in several cases where the Laplace transform method fails.

517.94 : [535.13 + 538.561 **1801**

On Cauchy's Problem for Hyperbolic Equations and the Differentiability of Solutions of Elliptic Equations.—P. D. Lax. (*Commun. pure appl. Math.*, Nov. 1955, Vol. 8, No. 4, pp. 615–633.) The Cauchy problem for symmetric hyperbolic systems of the first order is discussed; the class includes all equations in physics describing reversible time-dependent phenomena including Maxwell's equations, the equations of magnetohydrodynamics, etc. A theorem is presented on the differentiability of weak solutions of an elliptic equation of order $2m$.

517.948.3 **1802**

A New Method for solving Fredholm Integral Equations.—C. Müller. (*Commun. pure appl. Math.*, Nov. 1955, Vol. 8, No. 4, pp. 635–640.)

519.283 **1803**

Statistical Techniques for reducing the Experiment Time in Reliability Studies.—M. Sobel. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 179–202.)

MEASUREMENTS AND TEST GEAR

535.24 : 535.37 **1804**

Direct Measurement of Quantity of Light in Rapidly Decaying Luminescence Processes.—N. A. Tolstoi & I. A. Litvinenko. (*Zh. eksp. teor. Fiz.*, Oct. 1955, Vol. 29, No. 4 (10), pp. 507–515.) An instrument for measuring the time integral of the light-quantum output in the rise and the decay of luminescence is described; circuit and block diagrams are given. The processes investigated have equivalent exponential-curve time-constants between 10^{-8} and 10^{-1} sec.

621.3 : 621.319.4 : 537.523.3 **1805**

The Detection of Corona Discharges in High-Voltage Air Capacitors.—L. Medina. (*Aust. J. appl. Sci.*, Dec. 1955, Vol. 6, No. 4, pp. 453–457.) Corona discharge giving rise to increased power factor in capacitors used in a.c. bridges etc. may be detected by measurement of the direct component produced in the current through the capacitor.

621.3.018.4(083.74): 621.385.029.6 **1806**

A Method of forming a Broad-Band Microwave Frequency Spectrum.—R. E. Wall, Jr, & A. E. Harrison. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. MTT-3, No. 1, pp. 4–10.) The beam-accelerating voltage of a klystron is modulated by two h.f. voltages, one frequency being an integral multiple of the other; the sidebands so produced are suitable for use as microwave frequency standards.

621.317: 621.383.2 **1807**

The Photodianode: Modulation of the Differential Current by an Alternating Magnetic Field.—Deloffre, Pierre & Roig. (See 1895.)

621.317.3: 621.374.3: 621.372.8 **1808**

Waveguide Investigations with Millimicrosecond Pulses.—A. C. Beck. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 35–65.) Equipment for the generation, reception and display of 5-mμs pulses is described. Dominant-mode and multi-mode waveguide applications are considered. Resolution tests show the practicability with this technique of separating radar targets 4 ft apart. Pulses 70 dB below the level of the outgoing pulse can be observed.

621.317.3: 621.385.832.001.4 **1809**

Testing Cathode-Ray Tubes.—Nixon. (See 1919.)

621.317.3: 621.397.6 **1810**

State of Standardization of Test and Measurement Methods for Television Transmission Technique.—Müller. (See 1879.)

621.317.32: 621.396.61 **1811**

A Method for the Direct Measurement of Spurious Emissions.—S. Kurokawa, T. Takahashi & M. Arai. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 217–220.) Measurements in the frequency band 30–200 Mc/s are effected by use of a directional coupler to connect a screened selective receiver and output meter to the feed line from the transmitter.

621.317.326: 621.385.2 + 621.397.62 **1812**

The Response of Diode Circuits to Periodic Pulses.—Suhrmann. (See 1883.)

621.317.33: 621.384.622 **1813**

The Shunt Resistance of Linear Accelerators.—W. Chahid. (*C. R. Acad. Sci., Paris*, 9th Jan. 1956, Vol. 242, No. 2, pp. 244–247.) Application of the method of measuring cavity-resonator shunt resistance described previously (1324 of May). Results are compared with those obtained by the methods of Denis & Liot (1076 of 1948) and of Hall & Parzen (799 of 1954).

621.317.335 **1814**

Cell with Fixed Electrodes for Measurement of the Dielectric Constant of a Liquid.—C. Abgrall. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 76–78.) Details are given of the construction of a cell for use in the method described previously (1132 of 1954).

621.317.335.3.029.64 **1815**

The Measurement of Small Changes in Dielectric Constant by means of a Cavity Wavemeter.—E. S. Hotston & J. E. Houldin. (*J. sci. Instrum.*, Dec. 1955, Vol. 32, No. 12, pp. 484–485.) A modification of a cylindrical H_{01n} cavity-resonator design allows the dielectric constant to be determined from measurements including the length of the air-filled part of the resonator instead of the usual observation of the change of length of the resonator on insertion of the dielectric. At frequencies of about 9·6 kMc/s values obtained for dielectric constants of glass disks 0·08 in. thick were consistent to within 1 part in 750.

621.317.4: 621.318.2 **1816**

Precision Apparatus for Investigations of Aging in Permanent Magnets.—R. K. Tenzer. (*Arch. tech. Messen*, Dec. 1955, No. 239, pp. 285–288.) Apparatus developed in connection with the investigations described by Kronenberg (772 of 1954) is designed for ballistic measurements of induction using a compensation principle; the voltage pulse induced in the test coil when it is withdrawn from the permanent magnet is balanced against a pulse of known amplitude.

621.317.42.082.72 **1817**

A New Magnetic Flux Probe.—J. E. Parton & G. D. Stairmand. (*J. sci. Instrum.*, Dec. 1955, Vol. 32, No. 12, pp. 464–467.) A differential-capacitance probe suitable for use in steady or transient fields of strength above 100 G is described. It comprises three parallel members, the middle one of which is current-carrying. This member is deflected by the magnetic field so that its capacitance to the earthed outer members changes. The change is detected by means of a bridge circuit.

621.317.7 **1818**

Electronic Measuring Instruments.—E. H. W. Banner. (*Elect. Rev., Lond.*, 30th Dec. 1955, Vol. 157, No. 27, pp. 1264–1267.) The different classes of commercially available voltmeter and testing set are indicated, and an example of each is briefly described.

621.317.729 **1819**

A Simple Equipment for solving Potential and other Field Problems.—C. T. Murray & D. L. Hollway. (*J. sci. Instrum.*, Dec. 1955, Vol. 32, No. 12, pp. 481–483.) Two-dimensional field problems are solved by using, as an electrical analogue, current flow in a sheet of ordinary paper, where pencil lines mark the electrode boundaries. Details of the circuit and the construction of the equipment are given.

621.317.729 **1820**

An Electrolytic-Tank Equipment for the Determination of Electron Trajectories, Potential and Gradient.—D. L. Hollway. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 155–160. Discussion, pp. 163–165.) A description is given of equipment for testing either axially symmetric or two-dimensional systems; it can be switched to measure potential gradients, and to trace electron trajectories. The accuracy is sufficient for most problems of electrode design.

621.317.729: 538.691 **1821**

A Method of tracing Electron Trajectories in Crossed Electric and Magnetic Fields.—D. L. Hollway. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 161–163. Discussion, pp. 163–165.) An extension of Gabor's tangent method (*Nature, Lond.*, 27th Feb. 1937, Vol. 139, No. 3513, p. 373) is used. Comparison of results with calculated paths for a trochoid indicates that the accuracy is satisfactory, being almost equal to that in purely electric fields.

621.317.73.029.64 **1822**

Automatic Plotter for Waveguide Impedance.—H. L. Bachman. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 184–187.) The input impedance of a waveguide component is automatically measured over the frequency range 8·5–9·6 kMc/s, the impedance locus in

the reflection-coefficient plane being displayed on a c.r.o. screen. Comparison with slotted-line measurements indicates that the maximum errors in magnitude and phase of the reflection coefficient are 10% and 5° respectively, occurring at the ends of the frequency band. See also *Trans. Inst. Radio Engrs*, Jan. 1955, Vol. MTT-3, No. 1, pp. 22–30.

621.317.755 **1823**

A Multi-trace Cathode-Ray-Tube Display.—K. E. Wood & T. C. Keenan. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 105–107.) Equipment for displaying nine traces sequentially derives the switching waveform from a neon counter. Input frequencies up to 100 c/s can be displayed.

621.317.755 **1824**

An Ultra-high-Speed Oscillograph.—F. R. Connor. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 178–181.) The instrument described has a linear sweep speed of 2·5 cm/mμs, with a full scan of 5 cm, and incorporates a c.r. tube with small plate systems. The Y-plate system is designed as a transmission line which can be either resonant or nonresonant, thus providing for narrow-band or wide-band matching. A coaxial-cable delay unit is included, and a calibrating circuit provides a 1·25-kMc/s timing waveform.

621.317.755 **1825**

Cathode-Ray Oscilloscope Intensity Modulator.—R. F. Kemp. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, pp. 1120–1121.) A voltage derived by a push-pull differentiating amplifier from the vertical deflection signal is added to the brilliancy control voltage, thus preventing variation of trace brightness due to variation of writing speed.

621.317.755 **1826**

Equipment for the Vectorial Display of Alternating Voltages in the Frequency Range 5–215 k/cs.—E. C. Pyatt. (*J. sci. Instrum.*, Dec. 1955, Vol. 32, No. 12, pp. 469–471.) A c.r.o. giving an Argand-diagram display is described; applications to measurements on electromechanical devices are indicated.

621.317.76 **1827**

Wavelength Measurement in the Millimeter Region.—H. H. Theissing & J. McCue. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, pp. 1203–1204.) Outline description of an interferometer arrangement using two nearly parallel semitransparent metal films interposed between source and detector.

621.317.761 **1828**

Electronic Device for measuring Reciprocal Time Intervals.—E. F. MacNichol, Jr, & J. A. H. Jacobs. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, pp. 1176–1180.) The device described, which is designed for the lower a.f. range, converts a train of electrical pulses into a succession of hyperbolic waveforms of amplitude proportional to the interval between successive pulses. These waveforms are displayed on a c.r.o.; sudden changes in frequency are indicated immediately.

621.317.789.029.6 **1829**

A Film Radiometer for Centimetre Wavelengths.—J. A. Lane. (*Nature, Lond.*, 25th Feb. 1956, Vol. 177, No. 4504, p. 392.) Preliminary experiments are briefly described on the development of a device affording the possibility of accurate substitution of d.c. power for cm-λ power. A narrow strip of resistive film is arranged transversely in a standard 3-cm-band waveguide, between the centres of the broad faces. With a reflecting plunger fixed at a distance $\lambda_g/4$ behind the strip, a voltage s.w.r. of 0·9 or better can be achieved over a 10% bandwidth. The power can be determined by observing either the change of resistance or the rise in temperature.

621.318.4(083.74) **1830**

A Standard of Mutual Inductance.—J. T. Henderson & M. Romanowski. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 856–870.) The construction and measurement of a Campbell-type standard mutual inductor for the National Research Council of Canada is described. Its calculated value is 0·010 007 24$_8$ H, with and error $\geq$ 13 parts per million.

621.318.4(083.74) **1831**

Considerations on the Primary Winding of the Campbell Standard Inductor.—M. Romanowski & P. A. Fraser. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 871–885.) Estimates are made of the effect of the presence of the quartz cylinder and of the finite cross-section of the primary wire on the value of the standard inductor described by Henderson & Romanowski (1830 above).

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534-8 **1832**

Industrial Applications of Ultrasonics.—E. G. Richardson. (*Brit. J. appl. Phys.*, Dec. 1955, Vol. 6, No. 12, pp. 413–415.) Modern techniques are described with particular reference to echo detecting, high-frequency agitation and metallurgical applications. The possibilities and limitations of ultrasonics for these purposes are discussed.

538.566.029.6: 541.126 **1833**

Microwave Observation of Detonation.—J. L. Farrands & G. F. Cawsey. (*Nature, Lond.*, 7th Jan. 1956, Vol. 177, No. 4497, pp. 34–35.) A method of measuring the velocity of detonation of high explosives under contained conditions is described, based on principles of microwave interferometry.

621-52: 681.142 **1834**

Digital Methods in Control Systems.—D. F. Nettell. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 108–114.) The application of digital computer techniques to factory automation is discussed, with special reference to the use of digital methods with existing analogue installations.

621.317.39: 531.71 **1835**

Noncontacting Gages for Nonferrous Metals.—R. B. Colten. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 171–173.) Two gauges for Cu and Al from 0·003 to 0·5 in. thick are based on measurement of skin effect. Cu strip passing the pickup head is gauged and recorded at a rate of 300 ft/min.

621.317.39: 621.383.27 **1836**

Aerosoloscope counts Particles in Gas.—E. S. Gordon, D. C. Maxwell, Jr, & N. E. Alexander. (*Electronics*, March 1956, Vol. 29, No. 3, pp. 188–192.) Light scattered by an aerosol beam is received by a photomultiplier and the resulting random voltage pulses are analysed in a pulse-height discriminator and counted in twelve groups, thus giving the number and size distribution of the particles. The instrument is accurate for particles of diameter 1–64 μ, and concentrations up to 10 000 particles/cm^3 can be dealt with, at a maximum counting rate of 100/sec.

621.326.73 **1837**

A Uniform Blackbody Light Source excited by Radio Frequency.—S. C. Peek. (*J. Soc. Mot. Pict. Telev. Engrs*, Dec. 1955, Vol. 64, No. 12, pp. 671–673. Discussion, p. 673.) The lamp comprises a $\frac{1}{16}$-in. tantalum carbide disk supported by a zirconium oxide rod and heated by r.f. induction. The lamp can be operated at a brightness of up to 50 000 candles/in².

621.384.6 : 621.319.3 **1838**

An Electrostatic Particle Accelerator.—D. R. Chick & D. P. R. Petrie. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 132–145. Discussion, pp. 152–154.) Equipment combining a pressurized charged-belt e.s. generator and a multi-section ion-accelerator tube is described. Proton beams have been obtained with energy up to 3·25 MeV and an energy resolution of 1 in 1 200.

621.384.612 **1839**

Synchrotron Oscillations in Strong-Focusing Accelerators.—L. L. Goldin & D. G. Koškarev. (*Nuovo Cim.*, 1st Dec. 1955, Vol. 2, No. 6, pp. 1251–1268. In English.) Linear theory is presented.

621.384.612 **1840**

Gas Scattering in a Strong-Focusing Electron Synchrotron.—M. J. Moravcsik & J. M. Sellen, Jr. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, pp. 1158–1164.)

621.385.833 **1841**

The EM 75 kV, an Electron Microscope of Simplified Construction.—A. C. van Dorsten & J. B. Le Poole. (*Philips tech. Rev.*, Aug. 1955, Vol. 17, No. 2, pp. 47–59.) An instrument giving a resolving power of at least 100 Å has magnetic condenser, objective and projector lenses.

621.385.833 **1842**

The Testing of some Adjustable Permanent-Magnet Electron Lenses.—G. Langner. (*Optik, Stuttgart*, 1955, Vol. 12, No. 12, pp. 554–562.)

621.385.833 : 538.221 **1843**

Magnetic Contrast in Electronic Mirrors and Observation of Domains in a Ferromagnetic Material.—Spivak, Prilezhaeva & Azovtsev. (See 1794.)

621.386 : 778.33 : 621.383.8 : 621.385.832 **1844**

X-Ray Images made Visible by means of a Television Pickup Tube responding to X Rays.—Keller & Ploke. (See 1901.)

621.387.422 **1845**

The Discharge Mechanism in an Argon-Filled Proportional Counter.—K. Schütt. (*Z. Phys.*, 22nd Dec. 1955, Vol. 143, No. 4, pp. 489–512.)

621.389 **1846**

Applications of the Optics of Electric Charges to Mass Spectrometry.—R. Vauthier. (*Ann. Phys., Paris*, Nov./Dec. 1955, Vol. 10, pp. 968–1025.)

621.9 : 537.523.4 **1847**

High-Frequency Electro-spark Machining of Hard Metals.—(*Microtecnic*, 1955, Vol. 9, No. 5, pp. 267–271.) The technique discussed involves production of a nonoscillating spark discharge lasting a few microseconds, with current density of the order of 10^5 A/mm². Some details are given of a machine with a spark frequency variable from 2 500/sec to tens of thousands per sec.

PROPAGATION OF WAVES

621.396.11 **1848**

Propagation of Electromagnetic Waves over a Flat Earth across Two Boundaries separating Three Different Media.—K. Furutsu. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 239–279.) A theoretical paper. Formulae involving integrals are derived for field strength; calculated values are compared with observed values for several examples of propagation across a land/water boundary.

621.396.11 : 551.510.535 **1849**

Divergence Factor of the Wave Reflected from the Surface of the Ionosphere.—H. Uyeda, T. Kitsunezaki & Y. Arima. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 311–327.) The effect of curvature of the surface of the ionosphere on the field strength of the reflected wave is discussed. A 'divergence factor' expressing the energy loss on reflection from an infinitesimally small area is defined and a formula for it is deduced. The results for ellipsoidal and sinusoidal ionosphere surfaces are examined in detail.

621.396.11 : 551.510.535 **1850**

Radio Observations of the Ionosphere at Oblique Incidence.—J. H. Chapman, K. Davies & C. A. Littlewood. (*Canad. J. Phys.*, Dec. 1955, Vol. 33, No. 12, pp. 713–722.) Automatic vertical-incidence sounding equipment has been adapted for use in oblique-incidence measurements over the 2 355-km path between Ottawa and Saskatoon. Typical records are shown and discussed. Accepted theory relating vertical-incidence and oblique-incidence propagation is verified by comparison with vertical-incidence soundings taken at a station 200 km from the mid-point of the path. See also 1138 of 1955 (Cox & Davies).

621.396.11 : 621.396.674 **1851**

Propagation of Transient Fields from Dipoles near the Ground.—H. Poritsky. (*Brit. J. appl. Phys.*, Dec. 1955, Vol. 6, No. 12, pp. 421–426.) The analysis presented is based on the resolution of a spherical wave into proper plane waves. A double-integral representation is obtained for the Hertz potential of the field. For a vertical dipole on the ground one of the integrations is carried out for the region above the ground and for a conical region underground, while the second integration is carried out for special directions and locations.

621.396.11.029.55 **1852**

Analysis of Sky-Wave Field Intensity.—S. N. Mitra & R. B. L. Srivastava. (*Indian J. Phys.*, April & May 1955, Vol. 29, Nos. 4 & 5, pp. 167–178 & 227–242.) Measurements of the field strength of s.w. transmissions from Bombay, Calcutta and Madras made at Delhi over the period 1942–1952 are analysed. The yearly, seasonal and monthly variations and their correlation with sunspot numbers are shown graphically. An unexplained feature of the observations is the correlation of night-time field strength with solar activity. The observations are compared with values calculated by the C.R.P.L. and S.P.I.M. methods; neither of these is strictly applicable to propagation conditions in India or in the tropics generally.

621.396.11.029.55 **1853**

Ionospheric Propagation of Decametre Waves and Form of Second-Marking Pulses in Standard Amplitude-Modulated Transmissions.—J. Bouchard & A. Helaine. (*C. R. Acad. Sci., Paris*, 23rd Jan. 1956, Vol. 242, No. 4, pp. 480–482.) Continuation of the investigation reported previously by Bouchard (1783 of 1953). Oscillograms of the

time-signal pulses from WWV and WWVH have been recorded and examined in relation to propagation conditions at the relevant time. Various forms of distortion are observed.

621.396.11.029.55 : 551.510.535 **1854**

A Study of Ionospheric Propagation by means of Ground Back-Scatter.—E. D. R. Shearman. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 203–209. Discussion, pp. 232–235.) "The results of a year's observations in southern England of long-range back-scatter are analysed. A pulse transmitter coupled to alternative directional aerials was used, and transmissions were made at noon each day on a number of frequencies between 10 and 27 Mc/s. The echo patterns observed in winter were simple and were formed by echoes from the ground just beyond the skip distances for one- and two-hop F_2-layer propagation. In summer, however, ground echoes returning by way of the E_s, E and F_1 layers arrived nearly simultaneously and were difficult to distinguish. The marked increase in E_s ionization in summer could be seen clearly from the echo patterns. Examples of fixed frequency range-time recordings (p'*t*) of back-scatter are given. On one record echoes can be seen at ranges corresponding to each of the ground reflection points for four-hop F_2 propagation between England and Malaya. The application of the $p't'$ technique to the direct measurement of maximum usable frequencies is described. To assess the accuracy of the back-scatter technique of skip-distance measurement, comparisons were made between measured scatter ranges calculated from vertical-incidence ionosphere measurements. The measured ranges were consistently shorter than those calculated. It is uncertain whether this discrepancy arises from approximations in the theory used for the calculations from vertical-incidence data or from inadequate directivity in the aerials used in the scatter measurements. Comparisons of scatter ranges with direct measurements of m.u.f. over the same path are considered desirable to resolve this uncertainty."

621.396.11.029.55 : 551.510.535 **1855**

The Technique of Ionospheric Investigation using Ground Back-Scatter.—E. D. R. Shearman. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 210–223. Discussion, pp. 232–235.) "The skip distance in short-wave propagation is measured by observing the time delay of echoes scattered from the earth's surface beyond the skip distance. A theoretical study shows that the method should give good accuracy in determining skip distance, but cannot yield unique values of the height and critical frequency of an ionospheric layer at a distant point. The radar equation is used to find the intensity of back-scatter from the ground, and an approximate calculation indicates that the irregularities present on land and sea should be sufficient to explain the observed echo strength. The effect of ray focusing by the ionosphere is considered. Experimental results confirm the conclusions of other workers that the predominant sources of echoes are on the ground and not in the E region. An empirical correction for the effect of the earth's magnetic field shows that no error in the location of the sources is introduced by using no-field theory in the analysis of results."

621.396.11.029.55 : 551.510.535 **1856**

An Experiment to test the Reciprocal Radio Transmission Conditions over an Ionospheric Path of 740 km.—R. W. Meadows. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 224–226. Discussion, pp. 232–235.) "Two-way pulse transmissions made simultaneously on the same frequency (5·1 Mc/s approximately) between Slough and Inverness (740 km) are described. An aerial common to transmitter and receiver was used at each terminal, and the fading patterns displayed at each end were compared visually: the Inverness display was relayed to Slough over a Post Office trunk line for this purpose. The fading of corresponding echoes was found to be non-reciprocal for about 1% of the time during a total period of observation of about 15 daylight hours spread over 13 days in May, 1954. The precautions taken to ensure that the effects were ionospheric and not instrumental are outlined."

621.396.11.029.55 : 551.510.535 **1857**

An Experimental Test of Reciprocal Transmission over Two Long-Distance High-Frequency Radio Circuits.—F. J. M. Laver & H. Stanesby. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 227–232. Discussion, pp. 232–235.) "The results obtained both across the North Atlantic and between Australia and the United Kingdom show that at times the loss in both directions is substantially the same, and that at other times the loss difference can rise to values of the order of 5 or 10 dB. Usually the loss differences were such that signals outwards from the United Kingdom suffered the greater attenuation, but without further evidence it would be unwise to assume that this tendency is permanent."

621.396.11.029.6 : 551.510.52 **1858**

On the Propagation of Ultra-short Waves beyond the Horizon.—K. Tao. (*Japanese J. Geophys.*, May 1954, Vol. 1, No. 1, pp. 27–79.) General analysis is presented for propagation in the diffraction region. The propagation modes are considered for a three-layer troposphere with the refractive index varying linearly with height in each layer. Refractive-index gradients are calculated from aerological data and standard propagation is studied by comparing calculated and observed values of field strength.

621.396.11.029.62 **1859**

Uses of Diffraction Effect of Mountains for V.H.F. Radiocommunication.—T. Kono, M. Hirai & Y. Uesugi. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 293–309.) Results with a receiver placed in the diffraction field at a point where the received field strength is high and not critically dependent on location show that the field strength varies very little with time; reliable communication can be established over a distance of 300–400 km. See also 2093 of 1955 (Kono et al.).

621.396.11.029.62 **1860**

V.H.F. Propagation by Ionospheric Scattering and its Application to Long-Distance Communication.—W. J. Bray, J. A. Saxton, R. W. White & G. W. Luscombe. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 236–257. Discussion, pp. 257–260.) "The paper describes an investigation of the propagation of v.h.f. radio waves by scattering from the E-region of the ionosphere. The dependence of the characteristics of the received signal on frequency, distance and aerial directivity is examined, and observations are made on the diurnal and seasonal variations of the received signal strength; the results are discussed in relation to existing theories. Investigations are also described on the suitability of this form of propagation for the transmission of frequency-shift telegraphy signals, and for telephony signals transmitted by single-sideband amplitude modulation, and by phase modulation, of a carrier. A form of wave-angle diversity reception which yields a substantial improvement in the performance of a telegraphy system is described. The possible applications of v.h.f. scatter propagation to commercial services are discussed."

RECEPTION

621.376.332 : 621.374.32 **1861**

Low-Distortion F.M. Discriminator.—M. G. Scroggie. (*Wireless World*, April 1956, Vol. 62, No. 4, pp. 158–162.) The operation of a resistance-coupled pulse-counting discriminator circuit is described. A circuit diagram of the limiter and discriminator and the characteristic curves are given.

621.396.812.3 **1862**

Diversity Reception with Correlated Signals.—H. Staras. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 93–94.) The variation of diversity advantage with degree of correlation of the signals at two spaced receivers is examined.

621.396.82 **1863**

Required Interference Protection Ratios for the Field Strengths of Two Medium-Wave Transmitters as a Function of their Frequency Separation.—E. Belger & F. von Rautenfeld. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 11/12, pp. 235–237.) A preliminary report is presented of listener tests made on two simultaneous transmissions at frequencies in the region of 1 Mc/s, using two commercially available broadcast receivers, one wide-band and the other narrow-band. The required interference protection ratios and the relative strengths of carrier and modulation interference effects are plotted as functions of frequency separation.

621.396.822 : 621.376.232.2 **1864**

On the Time Constants of Linear Detectors used in Radio Noise Measurements.—K. Kawakami & H. Akima. (*J. Radio Res. Labs, Japan*, July 1955, Vol. 2, No. 9, pp. 221–234.) The relations between output voltage and detector time constant are investigated for various types of radio noise and a method of waveform determination is deduced. Noise is classified according to the output characteristic obtained when the detector circuit constants are varied; a 'sharpness factor' and a 'fineness factor' are defined.

STATIONS AND COMMUNICATION SYSTEMS

621.39.001.11 **1865**

A Class of Binary Signaling Alphabets.—D. Slepian. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 203–234.)

621.396.11.029.62 **1866**

V.H.F. Propagation by Ionospheric Scattering and its Application to Long-Distance Communication.—Bray, Saxton, White & Luscombe. (See 1860.)

621.396.41 + 621.395.43] : 621.376.3 **1867**

An Extended Analysis of Echo Distortion in the F.M. Transmission of Frequency-Division Multiplex.—R. G. Medhurst & G. F. Small. (*Proc. Instn elect. Engrs*, Part B, March 1956, Vol. 103, No. 8, pp. 190–198.) By a combination of analytical and semi-empirical methods, Albersheim & Schafer's results (2022 of 1952) are extended to cover a wider range of cases. See also 247 of 1954 (Medhurst).

621.396.93 + 621.396.96 **1868**

Symposium on Marine Communications and Navigation.—(See 1726.)

621.396.97 : 621.396.82 **1869**

Improvement of Reception in Shared-Channel Operation by means of Frequency Offset.—E. Belger & F. von Rautenfeld. (*Tech. Hausmitt. Nordw-Dtsch. Rdfunks*, 1955, Vol. 7, Nos. 11/12, pp. 232–234.) Listener tests indicate that the interference protection ratio required in a shared channel is increased if the carriers are separated by about 2 c/s but is slightly reduced if the separation is about 15 c/s. When the channel is shared by a number of transmitters two or three different frequencies may be used depending on the frequency constancy of the transmitters.

SUBSIDIARY APPARATUS

621.316.722.1 **1870**

Mains-Voltage Stabilizers.—R. B. Stephens. (*Philips tech. Rev.*, July 1955, Vol. 17, No. 1, pp. 1–9.) A fast-acting stabilizer is described combining features of the magnetic and feedback types. The voltage-sensitive element is a bridge containing an indirectly heated thermistor. A stability to within ± 0·5% over the temperature range 10–50°C can be achieved for mains voltage fluctuations between 180 and 250 V, mains frequency variations between 47 and 51·5 c/s, and load variations from no load to full load. Recovery time is 1–2 cycles.

621.35 : 539.169 **1871**

Nuclear Batteries: Types and Possible Uses.—A. Thomas. (*Nucleonics*, Nov. 1955, Vol. 13, No. 11, pp. 129–133.)

621.352.32 **1872**

Depolarization of Electrochemical Cells containing Manganese Dioxide.—J. Brenet, P. Malessan & A. Grund. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 111–112.)

621.355 **1873**

Recent Patents on Electrical Accumulators.—L. Jumau. (*Rev. gén. Élect.*, Nov. & Dec. 1955, Vol. 64, Nos. 11 & 12, pp. 537–554 & 602–616.) For previous review, see 2230 of 1954.

TELEVISION AND PHOTOTELEGRAPHY

621.397.24 **1874**

Developments in Closed-Circuit Television.—M. H. Kraus. (*Elect. Engng, N.Y.*, Nov. 1955, Vol. 74, No. 11, pp. 974–979.) Multichannel distribution systems are discussed with particular reference to systems installed at Fort Monmouth and at the Case Institute of Technology. To be published in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, 1955, Vol. 74.

621.397.5 : 535.623 **1875**

American Colour Television: the Present State.—D. C. Birkinshaw. (*J. Telev. Soc.*, Oct.–Dec. 1955, Vol. 7, No. 12, pp. 509–515.) Report based on a survey made in April 1955. It is concluded that premature launching of colour television in Great Britain should be guarded against, that the picture tube is of paramount importance, and that a more sensitive camera is needed to make outside broadcasts satisfactory.

621.397.5 : 535.623 **1876**

Recent Developments in Colour Television.—L. C. Jesty. (*J. Telev. Soc.*, Oct.–Dec. 1955, Vol. 7,

No. 12, pp. 488–508.) Text of a paper read to the Society in April 1955. Various recent experiments in the U.S.A. and Great Britain are referred to. The importance of the picture tube is emphasized and possible alternatives to the tricolor-phosphor-dot shadow-mask type are mentioned, including flat constructions. Fundamental changes in television transmission systems by 1970 or 1980 are considered likely; for instance, a system in which each picture point is permanently associated with an individual channel would not be impossible.

621.397.6: 535.623 **1877**

Fixing the Value of the Colour Carrier in a European Colour-Television System based on the N.T.S.C. System.—F. Jaeschke. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 11/12, pp. 224–228.) Investigations of the best method of adapting the N.T.S.C. system to the 625-line standards lead to the recommendation of a colour-subcarrier frequency of 4·210 937 5 Mc/s; a fixed phase relation between sound and colour carriers is then possible. Combinations of frequency dividers, modulators and filters for effecting the necessary frequency conversions are described. See also 1878 below.

621.397.6: 535.623 **1878**

The Position of the Colour Subcarrier in a Possible Adaptation of the N.T.S.C. System to the 625-Line C.C.I.R. Standard.—F. Below & E. Schwartz. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 11/12, pp. 229–232.) The frequency corresponding on the C.C.I.R. standard to the N.T.S.C. colour-subcarrier frequency is about 4·26 Mc/s. Reasons are given for choosing a lower frequency, particularly 4·101 562 5 Mc/s; this is easier to divide than that recommended by Jaeschke (1877 above). A simple frequency-conversion arrangement is described. The final choice will be influenced by results of experiments in progress.

621.397.6: 621.317.3 **1879**

State of Standardization of Test and Measurement Methods for Television Transmission Technique.—J. Müller. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7. Nos. 11/12, pp. 209–216.) Test methods recommended by the German authorities are discussed and compared with those used in other countries. See also 1489 of May (Macek).

621.397.61 **1880**

Black-Level Control in Television Pickup Apparatus.—W. Dillenburger. (*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1955, Vol. 7, Nos. 11/12, pp. 217–223.) An examination is made of the extent to which the fly-back potential of different types of pickup apparatus bears a constant relation to picture black level. Clamp circuits are discussed; operation is facilitated by black-level control at the lowest brightness level. The control process is imperceptible with circuit time constants of 0·5–1 sec. An improved automatic black-level control circuit is described.

621.397.62: 535.623 **1881**

Color Television Receiver Design—a Review of Current Practice [in the U.S.A.].—R. G. Clapp, E. G. Clark, G. Howitt, H. E. Beste, E. E. Sanford, M. O. Pyle & R. J. Farber. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 297–321.) The review deals with the design of commercial receivers using shadow-mask picture tubes.

621.397.62: 535.623 **1882**

Experimental Colour Receiver.—H. A. Fairhurst. (*Wireless World*, March & April 1956, Vol. 62, Nos. 3 & 4, pp. 112–118 & 183–187.) The design of a receiver for the British N.T.S.C. system (3095 of 1955) is described. A 21-in. R.C.A. shadow-mask c.r. tube is used.

621.397.62 + 621.317.326]: 621.385.2 **1883**

The Response of Diode Circuits to Periodic Pulses.—R. Suhrmann. (*Nachrichtentech. Z.*, Dec. 1955, Vol. 8, No. 12, pp. 659–665.) Analysis is presented relevant to the operation of diodes for restoring the d.c. component in television receivers and for peak-voltage measurements. Calculations are based on the initial exponential region of the diode characteristic. For practical purposes the resistance of the diode during the charging of the associated capacitor can be assumed constant; its value may be anything from 1 to 100 kΩ.

621.397.7 **1884**

The Marconi Television Centre.—T. W. Pace. (*J. Telev. Soc.*, Oct.–Dec. 1955, Vol. 7, No. 12, pp. 520–522.) Description of a studio in London, specially equipped for equipment testing and demonstrating and for personnel training.

621.397.813: 621.397.611 **1885**

Television Vertical Aperture Compensation.—A. C. Schroeder & W. G. Gibson. (*J. Soc. Mot. Pict. Telev. Engrs*, Dec. 1955, Vol. 64, No. 12, pp. 660–670.) A method is described involving defocusing and refocusing at a rapid rate, thus yielding high- and low-resolution signals whose difference gives the aperture-compensated signal. A similar method using vertical-deflection wobble rather than focus wobble results in vertical aperture compensation only.

TRANSMISSION

621.396.61: 621.317.32 **1886**

A Method for the Direct Measurement of Spurious Emissions.—Kurokawa, Takahashi & Arai. (See 1811.)

VALVES AND THERMIONICS

537.58: 537.311.33 **1887**

Thermionic Constants of Semiconductors.—K. S. Krishnan & S. C. Jain. (*Nature, Lond.*, 11th Feb. 1956, Vol. 177, No. 4502, p. 285.) The method of determining the constants described previously [3467 of 1952 (Jain & Krishnan)] is used to investigate Ni ribbons coated with triple carbonates of Ba, Sr and Ca. The currents corresponding to zero field fitted Richardson's equation well, with $\phi = 1{\cdot}55$ eV and $A = 48$ A. cm^{-2} deg^{-2}.

621.314.63 **1888**

Note on a Particular [semiconductor] **Structure permitting Production of High-Frequency Oscillations.**—A. Leblond & R. Gentner. (*C. R. Acad. Sci., Paris*, 30th Jan. 1956, Vol. 242, No. 5, pp. 621–623.) Experiments have been made with a *p-i* diode having metal electrodes making linear-resistance contacts. For thicknesses of the *i* region not greater than about a dozen microns, the low-temperature characteristic exhibits a negative-resistance region; stable relaxation oscillations at 35 Mc/s have been observed.

621.314.632 : 537.311.33 **1889**

The Influence of Frequency on the Rectifying Properties of Semiconducting Diodes at Low Alternating Voltages.—S. G. Kalashnikov & N. A. Penin. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1111–1123.) The frequency dependence of the rectified current is explained in terms of the capacitance of the *p-n* junction. This capacitance is due to the injection of carriers into the junction, and also to the displacement current. Simple expressions are derived for the limiting frequency and the frequency dependence of the rectified current under various operating conditions. The effects of the semiconductor properties on the frequency characteristics are also discussed.

621.314.7 **1890**

Diffused Emitter and Base Silicon Transistors.—M. Tanenbaum & D. E. Thomas. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 1–22.) Techniques are described for making Si *n-p-n* transistors by diffusing impurities from the vapour phase. Base layers $3{\cdot}8 \times 10^{-4}$ cm thick have been produced. Characteristics are presented of a transistor for which $\alpha_0 = 0{\cdot}97$ and cut-off frequency is 120 Mc/s. The structure and design of these transistors are discussed. For a brief version, see *Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 137–139 (Carroll).

621.314.7 **1891**

A High-Frequency Diffused-Base Germanium Transistor.—C. A. Lee. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 23–34.) Techniques of impurity diffusion and alloying in Ge are discussed. Examples are given of Ge *p-n-p* junction transistors in which $\alpha_0 = 0{\cdot}98$ and cut-off frequency is 500 Mc/s. For a brief version, see *Electronics*, Feb. 1956, Vol. 29, No. 2, pp. 137–139 (Carroll).

621.314.7 : 621.3.015.3 **1892**

Transfer Characteristic of Semiconductor Triodes.—E. I. Adirovich & V. G. Kolotilova. (*C. R. Acad. Sci. U.R.S.S.*, 1st Dec. 1955, Vol. 105, No. 4, pp. 709–712. In Russian.) An approximate expression is given for a function $g(t)$ in terms of parameters of the region between the emitter and collector, and the expression is used in deducing the effect of (*a*) a step and (*b*) a rectangular emitter current pulse.

621.314.7 : 621.373.431.2 **1893**

Junction Transistors with Alpha Greater than Unity.—H. Schenkel & H. Statz. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 360–371.) When the collector voltage of a junction transistor is raised to a level just below breakdown voltage, multiplication of charge carriers occurs and the alpha value rises above unity. The transistor characteristic corresponding to this condition of operation is investigated; the characteristic may be negative over a limited region. A free-running blocking oscillator using one transistor operated in this condition, and no transformer, is described.

621.314.7 : 621.396.822 **1894**

Measurements of Spontaneous Fluctuations in Currents with Different Carriers in Semiconductor Barrier Layers.—W. Guggenbühl & M. J. O. Strutt. (*Helv. phys. Acta*, 15th Dec. 1955, Vol. 28, No. 7, pp. 694–704. In German.) Measurements under 'white-noise' conditions indicate that when current in *p-n* junctions is produced either by applied voltage or by spontaneous creation of carriers, the fluctuations are consistent with Schottky's equations. In some recently developed alloyed-junction transistors the junction superimposes no additional fluctuations on the injected current, so that noise factors as good as those of high-vacuum valves can be obtained. See also 2778 and 3781 of 1955.

621.383.2 : 621.317 **1895**

The Photodianode: Modulation of the Differential Current by an Alternating Magnetic Field.—L. Deloffre, E. Pierre & J. Roig. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 98–100.) The device described previously (1737 of 1955 and back references) can conveniently be operated with a magnetic field of the order of 30 oersted applied parallel to the anodes. Frequencies up to 75 kc/s have been used.

621.383.27 **1896**

High-Speed Electron Multiplication by Transmission Secondary Electron Emission.—E. J. Sternglass. (*Rev. sci. Instrum.*, Dec. 1955, Vol. 26, No. 12, p. 1202.) Electron multipliers based on secondary emission from the rear sides of a series of plane-parallel insulating films is suggested. Tests on an experimental seven-stage device gave a delay in the response of $(3 \pm 1) \times 10^{-8}$ sec, with a pulse rise time of 10^{-9} sec. The results are discussed in relation to the use of such devices for resolving short time intervals.

621.383.4 : 535.371.07 **1897**

Solid-State Image Intensifiers.—G. Diemer, H. A. Klasens & J. G. van Santen. (*Philips Res. Rep.*, Dec. 1955, Vol. 10, No. 6, pp. 401–424.) "A theory is given of the characteristics of solid-state image intensifying screens consisting of a photoconducting and an electroluminescent layer, including the influence of positive internal feedback and negative electrical feedback. The possibilities of brightness as well as contrast amplification are discussed. With intermittent irradiation it is possible to increase the amplification factor by storage, due to the decay, or by triggering of a feedback amplifying-screen. In the latter case the gradation need not be lost. The dimensioning of the parameters with regard to specific applications (e.g. radar, X-ray images, television) is discussed. Preliminary experimental results are in agreement with theory. With X-rays a brightness-amplification factor of 30 was obtained with respect to a normal fluorescent X-ray screen."

621.383.42 **1898**

Modifications of the Spectral Sensitivity Curve of Selenium Photocells under the Influence of Temperature Variations.—G. Blet. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 95–98.) Measurements were made on cells of various types, at temperatures down to that of liquid helium. Complex variations of a generally similar nature were observed in all cases. Some results are shown graphically.

621.383.5 : 546.28 : 621.396.822 **1899**

Photovoltaic Noise in Silicon Broad Area *p-n* Junctions.—U. F. Gianola. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 51–54.) Photovoltaic cells of the type described by Fuller & Ditzenberger (1068 of 1955) exhibit a $1/f$ noise power spectrum under constant illumination. With varying illumination intensity the noise voltage exhibits a pronounced maximum. It is suggested that fluctuations in the primary photocurrent are produced as a result of traversing the junction; experimental evidence is presented in support of this view.

621.383.5 : 546.28 : 621.396.822 **1900**

Noise in Silicon *p-n* Junction Photocells.—G. L. Pearson, H. C. Montgomery & W. L. Feldmann. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, pp. 91–92.) "A silicon *p-n* junction photocell prepared by the gaseous diffusion process and biased in reverse showed no noise in excess of shot noise down to a frequency of 80 c/s in a dry atmosphere. In a humid atmosphere the excess noise was a factor of 3×10^6 above shot noise at 100 c/s and showed the familiar $1/f$ spectrum."

621.383.8 : 621.385.832 : 621.386 : 778.33 **1901**

X-Ray Images made Visible by means of a Television Pickup Tube responding to X Rays.—M. Keller & M. Ploke. (*Z. angew. Phys.*, Dec. 1955, Vol. 7, No. 12, pp. 562–571.) An iconoscope tube with an amorphous selenium photosensitive screen is described. The Se layer is 150 μ thick, possesses good storage properties and is not affected by the atmosphere. By using this tube in a closed-circuit television system, high luminosity and high-contrast X-ray images are obtainable.

621.385 **1902**

Irrotational Electron Beams.—J. Coste & J. L. Delcroix. (*C. R. Acad. Sci., Paris*, 9th Jan. 1956, Vol. 242, No. 2, pp. 236–238.) Theory presented by Gabor (362 of 1946) is extended to deal with relativistic beams. The general equation for monodromic irrotational beams is derived.

621.385.029.6 **1903**

Plasma Oscillations and Resonance Frequencies in a Magnetron in the Brillouin State.—J. Coste & J. L. Delcroix. (*C. R. Acad. Sci., Paris*, 4th Jan. 1956, Vol. 242, No. 1, pp. 87–90.) The system considered is a cylindrical whole-anode magnetron with the electrons describing circles round the axis. Analysis is based on a perturbation method. In general, the oscillations in the transverse plane comprise both radial and tangential components. Resonance frequencies are calculated by considering the anode/cathode system as a coaxial cavity.

621.385.029.6 **1904**

The O-Type Carcinotron Tube.—P. Palluel & A. K. Goldberger. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 333–345.) The O-type carcinotron is a backward-wave oscillator valve developed in France. Starting conditions deduced theoretically are compared with experimental results. The effects of reflections at the ends of the delay line are discussed and approximate expressions are derived for the efficiency and for frequency pushing. Design and performance data are given for a series of valves in production; each type covers about one octave, the whole series covering the frequency range 1–12 kMc/s. The maximum beam voltage is 1·5 kV and the r.f. outputs range from 100 mW to 1 W.

621.385.029.6(083.7) **1905**

I.R.E. Standards on Electron Devices: Definitions of Terms related to Microwave Tubes (Klystrons, Magnetrons, and Traveling Wave Tubes), 1956.—(*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 346–350.) Standard 56 I.R.E. 7.S1.

621.385.029.6 : 537.533 **1906**

Growing Waves due to Transverse Velocities.—J. R. Pierce & L. R. Waller. (*Bell Syst. tech. J.*, Jan. 1956, Vol. 35, No. 1, pp. 109–125.) Conditions are derived for the propagation of antisymmetrical and symmetrical growing waves in neutralized electron beams in which all electrons have the same velocity in the direction of propagation, but in which there are streams of two or more velocities normal to the direction of propagation.

621.385.029.6 : 621.372.2 **1907**

Definition, Measurement and Character of the Phase Velocities in Systems with Periodic Structure.—B. Epsztein & G. Mourier. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 64–73.) Analysis is presented elucidating the operation of lines with periodic structure in travelling-wave valves.

621.385.029.6 : 621.372.2 **1908**

Investigation of an Interdigital Line operating in the Vicinity of the Π Mode.—A. Leblond. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 83–91.) The effect of radiation from the line is examined; though not in general negligible, it is not great enough to invalidate determinations of Π-mode frequency and field distribution reported previously [1204 of 1955 (Leblond & Mourier)].

621.385.029.6 : 621.373.423 **1909**

Investigation of an Interdigital Line used as Anode Circuit for an U.H.F. Magnetron Oscillator. Distortions of the Electromagnetic Field.—A. Leblond. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 20–41.) Continuation of earlier work (289 of 1954). Effects due to mismatch of the output circuit are studied; these include modifications of the field distribution as compared with the unloaded condition for the same mode, and frequency pulling. Analysis is based directly on Maxwell's equations, without any simplifying assumptions.

621.385.032.2 **1910**

Determination of the Shapes of Electrodes for Pierce-Type Electron Guns.—R. Hechtel. (*Telefunken Ztg*, Dec. 1955, Vol. 28, No. 110, pp. 222–226. English summary, pp. 264–265.) A mathematical method is developed for obtaining a converging beam; its application is illustrated by the design of an electron gun with a semi-aperture angle of 45°.

621.385.032.2 : 537.533 **1911**

New Points of View in the Design of Electron Guns for Cylindrical Beams of High Space Charge.—M. Müller. (*J. Brit. Instn Radio Engrs*, Feb. 1956, Vol. 16, No. 2, pp. 83–94.) English translation of paper abstracted in 2478 of 1955.

621.385.032.21 : 537.533 **1912**

Electron Emission from a Lattice Step on Clean Tungsten.—J. K. Trolan, J. P. Barbour, E. E. Martin & W. P. Dyke. (*Phys. Rev.*, 15th Dec. 1955, Vol. 100, No. 6, pp. 1646–1649.) Experiments using pulsed T-F (temperature and field) emission are described; they afford the basis of technique for studying the transport of cathode material.

621.385.032.21 : 621.396.822 **1913**

The Influence of Cathode Standing Waves on Valve Stability.—W. W. H. Clarke. (*Brit. J. appl. Phys.*, Dec. 1955, Vol. 6, No. 12, pp. 433–441.) Experimental results indicate that the changes in the space-charge patterns of the virtual cathode of a valve are determined by the local variations of emission properties and by the boundary conditions of the cathode. Each pattern is associated with a particular current characteristic, so that a valve can have several preferred emission levels for constant applied potentials, intermediate

values of current being associated with patterns in a slightly unstable condition. The patterns change coherently and cause discrete current changes. The flicker effect may be related to these changes.

621.385.032.216 **1914**

Diffusion of Impurity Atoms in an Oxide Cathode through the Interface Layer.—N. D. Morgulis & Yu. G. Ptushinski. (*Zh. tekh. Fiz.*, June 1955, Vol. 25, No. 6, pp. 1157–1159.) The introduction of Si as an activator into the core of an oxide cathode results in the formation of Ba_2SiO_4 at the interface between the core and the oxide layer. This has a detrimental effect on the life of the cathode, possibly because with the growth of the Ba_2SiO_4 layer the diffusion of activating atoms from the core into the oxide layer becomes progressively more difficult. To verify this, an investigation was carried out using tracer atoms; the results are discussed.

621.385.032.216 **1915**

D.C. and Pulsed Emission from L-Cathodes.—I. Brodie. (*Proc. phys. Soc.*, 1st Dec. 1955, Vol. 68, No. 432B, pp. 1146–1148.) The difference between pulsed and d.c. emission from oxide cathodes [2091 and 3590 of 1949 (Wright)] is found also, to a lesser degree, in L-type cathodes and in these is considered to be due to partial removal of Ba from the cathode surface by positive-ion or gas bombardment.

621.385.032.216 **1916**

A New Pressed Dispenser Cathode.—P. P. Coppola & R. C. Hughes. (*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 351–359.) Description of the development of a moulded cathode consisting of CaBa aluminate dispersed in a porous matrix of W-Mo alloy. This type of cathode is suitable for operation in the temperature range 1 000–1 200°C, and has an emission density of 10 A/cm² and a lifetime > 5 000 h at an operating temperature of 1 130°C.

621.385.2.032.216 **1917**

Effect of the Cathode Work Function on the Space-Charge-Limited Characteristics of Plane Diodes.—C. R. Crowell. (*J. appl. Phys.*, Jan. 1956, Vol. 27, No. 1, p. 93.) An extension of Ferris's work (2099 of 1949). The diode characteristic is shown to be independent of the cathode work function until the current drawn is an appreciable fraction of the saturation current.

621.385.832 : 621.397.6 **1918**

Resolving Power of the Image Converter with Uniform Electrostatic and Magnetic Fields.—G. Wendt. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 74–82.) A calculation is made of the electron density distribution in the image point, taking the initial Maxwellian velocity distribution into account. The results are extended to the image of a line and a pattern of lines, and are compared with observations. Using a television test pattern, a definition of 100 lines/mm has been obtained on a screen of diameter 50 mm with an anode voltage of only 5 kV.

621.385.832.001.4 : 621.317.3 **1919**

Testing Cathode-Ray Tubes.—R. D. Nixon. (*Elect. J.*, 16th Dec. 1955, Vol. 155, No. 4044, pp. 2011–2012.) Brief details are given of life tests carried out by a manufacturer.

621.387 **1920**

Impedance-Frequency Characteristics of some Glow-Discharge Tubes.—F. A. Benson & G. Mayo. (*Electronic Engng*, March 1956, Vol. 28, No. 337, pp. 124–126.) Measurements in the frequency range 20 c/s–50 kc/s show that in every case the impedance of the tube increases considerably with frequency. The importance of ion inertia effects is emphasized.

621.387 **1921**

Ignition Sensitivity and Ignition Delay Time of Gas-Filled Triodes and Tetrodes.—E. Knoop. (*Z. angew. Phys.*, Dec. 1955, Vol. 7, No. 12, pp. 575–582.) Results of a theoretical and experimental investigation indicate that for good sensitivity the valve should be designed for a high geometrical penetration coefficient and the gas chosen should have a large ionization cross-section at not too low a pressure and at high ion velocity. The parameters and processes determining the delay time are discussed; the occurrence of maximum values of delay time is explained in relation to the adequacy of the supply of ions in the grid-anode space.

621.387 : 537.56 **1922**

The Gas-Multiplier: a New Type of Electron Multiplier.—C. H. Vincent. (*Nature, Lond.*, 25th Feb. 1956, Vol. 177, No. 4504, pp. 391–392.) A multi-stage device based on use of the Townsend electron avalanche process is described; multiplication by the α process is permitted, while the accompanying processes which cause positive feedback by releasing further electrons in the input region are restricted. The electrodes dividing the chamber into stages are plane, parallel and equally spaced, and have small holes in a central area. Conditions for operational stability are discussed.

MISCELLANEOUS

621.3 : 061.3 **1923**

1956 I.R.E. National Convention Program.—(*Proc. Inst. Radio Engrs*, March 1956, Vol. 44, No. 3, pp. 382–417.) Includes abstracts of the papers presented.

621.3.002.2 **1924**

Making Photo-etched Circuits in Your Workshop.—R. H. Dorf. (*Radio-Electronics*, Dec. 1955, Vol. 26, No. 12, pp. 56–58 & Jan. 1956, Vol. 27, No. 1, pp. 139 . . 148.) Simple instructions are given for preparing the circuit drawing, making the negative, sensitizing the laminated panel, exposing the panel, developing the image, and etching.

621.37 + 621.396] : 519.2 **1925**

Some Problems of Fluctuation in Radio.—J. C. Simon. (*Ann. Radioélect.*, Jan. 1955, Vol. 10, No. 39, pp. 3–19.) Statistical methods for summing vectors with random phase angles are discussed and the concept of correlation function is introduced. The theory is applied to an examination of various problems including multiple reflections on a transmission line, radiation from a large number of sources, fluctuations of a radar echo, influence of phase errors on aerial characteristics.

621.37/.39].004.6 **1926**

Prediction of Electronic Equipment Reliability.—V. Harris & M. M. Tall. (*Elect. Engng, N.Y.*, Nov. 1955, Vol. 74, No. 11, pp. 994–997.) A method is described based on failure data collected by the U.S. Navy.

621.385.832.002.2 : 621.397.621.2 **1927**

The Television Cathode-Ray-Tube Factory at Ulm [W. Germany].—C. F. Hühn. (*Telefunken Ztg.*, Dec. 1955, Vol. 28, No. 110, pp. 215–222. English summary, p. 264.) A plant completed in 1955 with a planned output of 50 000 picture tubes per month is described. Photographs and a flow chart are presented.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.121 **1928**

Forced Vibrations of a Rigid Circular Plate on a Semi-infinite Elastic Space and on an Elastic Stratum.—G. N. Bycroft. (*Phil. Trans. A*, 5th Jan. 1956, Vol. 248, No. 948, pp. 327–368.) An analytical paper.

534.2-14-8 **1929**

Measurement of Attenuation of [ultrasonic] **Sound in the Isothermal Surface-Layer of Water.**—A. N. Barkhatov. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 315–320.) Results obtained experimentally using a tank of water with a vertical temperature gradient are in reasonable agreement with the theory given by Brekhovskikh & Ivanov (3132 of 1955).

534.21-8 **1930**

Acoustic and Other Physical Properties of Shallow-Water Sediments off San Diego.—E. L. Hamilton, G. Shumway, H. W. Menard & C. J. Shipek. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 1–15.) The investigation reported covers in situ measurements of sound velocity on various sediments at 100 kc/s and laboratory measurements of velocity and attenuation at 23–41 kc/s on samples. In some cases the velocity in the sediment was less than the velocity in the bottom water; this result is discussed in a separate paper [*ibid.*, pp. 16–19 (Hamilton)].

534.213 **1931**

Propagation of Sound Pulses in a Dispersive Medium.—J. M. Proud, P. Tamarkin & E. T. Kornhauser. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 80–85.) Experiments are described in which rectangular pulses comprising many sound-wave cycles were propagated in a long rectangular channel containing water. The velocity of the main signal is different from that of the initial and final transients. Comparison of the observed beats between the initial transient and the main signal with results predicted from analysis shows good agreement, hence the technique can be used to predict the effect on more complex pulses after the system has been calibrated with rectangular pulses.

534.22 : 551.510.53 **1932**

Introductory Theory for Upper Atmosphere Wind and Sonic Velocity Determination by Sound Propagation.—Groves. (See 2046.)

534.231 **1933**

On the Dependence of Directivity Patterns on the Distance from the Emitter.—J. Pachner. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 86–90.) A method is presented for the numerical computation of the directivity pattern at any distance from the source based on the expansion of a diverging wave into a series of spherical wave functions. In a separate paper (*ibid.*, pp. 90–92) the method of analysis is extended to cover the investigation of standing-wave as well as travelling-wave field components.

534.231 : 519.24 **1934**

Propagation of Correlation Functions in Continuous Media.—R. H. Lyon. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 76–79.) The properties of noise fields produced by the random superposition of elementary sources are derived, using the method of analysis developed by Rice in connection with shot noise (2169 of 1945 and back references). A calculation is made of the correlation properties of the response of a continuous linear system exposed to a noise field, from a knowledge of the system impulse response and the correlation function of the source; the latter may be determined experimentally or by calculation.

534.232 **1935**

Sound Radiation from the Acoustic Boundary Layer.—U. Ingard & D. Pridmore-Brown. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 128–129.) "The sound radiated from a finite rectangular plate in an infinite wall oscillating in shear motion is calculated. The order of magnitude of the intensity of this sound field is compared with that which is produced when the plane oscillates with the same amplitude in a direction normal to its surface."

534.232: 546.431.824-31 **1936**

On the Resonant Vibrations of Thick Barium Titanate Disks.—E. A. G. Shaw. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 38–50.) Optical interference technique has been used to study the surface motion of $BaTiO_3$ disks with radius/semi-thickness ratios ranging from 1·14 to 6·63. Vibration patterns, resonance frequency and electromechanical coupling coefficients are given for 12 modes. There is no single mode that can be uniquely identified as the fundamental dilatational thickness resonance, but there is some evidence suggesting an optimum value of the ratio for transducer design.

534.232: 546.431.824-31 **1937**

Radial Vibrations in Short, Hollow Cylinders of Barium Titanate.—C. V. Stephenson. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 51–56.) A formula is developed, based on electrostriction equations, for determining the coupling coefficient of annular elements vibrating in the radial mode from the resonance and antiresonance frequencies. Many harmonics are found to be forbidden in this mode. Experimental evidence supports the theory presented.

534.24-14 **1938**

Underwater Sound Reflection from a Corrugated Surface.—E. O. LaCasce, Jr, & P. Tamarkin. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, pp. 138–148.) Experimental results are compared with results predicted by three different published theories. Good agreement is obtained in respect of direction of reflection and cut-off frequencies. The closeness of the agreement in respect of intensity depends on the surface slope; the theories appear to be valid only for small slope.

534.52 **1939**

Problem of Interaction of Sound Waves.—A. G. Gorelik & V. A. Zverev. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 339–342.) Report of an experimental investigation of the interaction of two sound waves traversing a liquid in mutually perpendicular directions.

534.6-8 **1940**

Experimental Determination of Ultrasonic Wave Pressure on Obstacles.—B. Ozdogan. (*J. Phys. Radium*, Dec. 1955, Vol. 16, No. 12, pp. 902–907.) Experiments using waves of frequency 1·5 Mc/s in water show that the coefficients of absorption for paraffin-wax and stearin surfaces increase with the angle of incidence. Curves show the variations of reflection and absorption coefficients with angle of incidence and with thickness of the absorbing layer.

534.61-8: 535.314 **1941**

Investigation of Stationary Ultrasonic Waves by Light Refraction.—A. P. Loeber & E. A. Hiedemann. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 27–35.) Continuation of work reported previously [2288 of 1954 (Kolb & Loeber)].

534.64 **1942**

Method of measuring Acoustic Impedance based on Measurement of the Geometrical Difference of Sound Pressures.—V. N. Fedorovich. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 360–367.)

534.75 **1943**

Sensitivity to Changes in the Interruption Rate of White Noise.—G. H. Mowbray, J. W. Gebhard & C. L. Byham. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 106–110.)

534.78 **1944**

Automatic Extraction of Formant Frequencies from Continuous Speech.—J. L. Flanagan. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 110–118.) Two electronic devices are described for deriving direct voltages corresponding to the first three formant frequencies. The performance of the devices is evaluated in a separate paper (*ibid.*, pp. 118–125).

534.845 **1945**

Absorption Characteristics of Upholstered Theater Chairs and Carpet as measured in Two Auditoriums.—R. N. Lane. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 101–105.) Measurements on a 496-seat and on a 738-seat auditorium are reported. The value found for the absorption per seat over the a.f. band is much lower than reported in various previous publications [e.g. 2198 of 1953 (Parkin et al.)].

534.85/.86: 534.76 **1946**

Two-Channel Stereophonic Sound Systems.—F. H. Brittain & D. M. Leakey. (*Wireless World*, May 1956, Vol. 62, No. 5, pp. 206–210.) The basic requirements for sound location are discussed and the effects of the directional characteristics of the microphones and loudspeakers and of the position of the listener on the sound image are described. Experimental results show that differences of sound intensity from the two loudspeakers afford better guidance in positioning the sound image than do the time differences.

534.861: 621.396.66 **1947**

Monitoring Sound Broadcast Programmes.—Somerville. (See 2221.)

621.395.623.7 **1948**

Loudspeakers with Spherical Radiation.—H. Schiesser. (*Rev. Son*, Jan. 1956, No. 33, pp. 4–10.) A discussion is presented of the departure from linearity of the frequency response of a cone loudspeaker as a function of the polar coordinates of the auditor's position. Improvements are possible by use of a spherical loudspeaker system. Practical approximations involving a number of loudspeakers mounted in the faces of a polyhedron are described, with an indication of suitable feed amplifier circuits. For practical purposes a hemispherical arrangement may be satisfactory. Systems for domestic receivers giving stereophonic reproduction are discussed.

534.839 **1949**

Notes on Applied Science No. 10. Noise Measurements Techniques. [Book Review]—Publishers: H.M. Stationery Office, London, 1955, 40 pp., 2s. (*Brit. J. appl. Phys.*, Jan. 1956, Vol. 7, No. 1, p. 41.) "... a guide to the choice of methods and techniques for determining the physical characteristics of noise, based on the experience of the National Physical Laboratory."

AERIALS AND TRANSMISSION LINES

621.315.212: 621.3.013.78: 621.317.3 **1950**

Measurement of Coupling Impedance and its Application to the Study of Cable Screens.—J. Bourseau & H. Sandjivy. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 11–30.) Various definitions of coupling (transfer) impedance are discussed, together with known methods for measuring it. A new direct method of measurement is described, using a bridge. An account is given of an application of the method to an investigation of screens for reducing crosstalk between coaxial pairs. Helical as well as cylindrical screens are discussed.

621.315.212.011.21 **1951**

Influence of Standard Splicing on the Uniformity of Impedance of a 2·6/9·4 Coaxial-Pair Cable.—R. Roch & J. Bouzitat. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 3–10.) Formulae are derived from the components and the modulus of the impedance deviation at the splices, which are assumed to comply with French Post Office standards. The frequency range considered is 2·45–4·1 Mc/s. A numerical example is included.

621.372.029.6 + 621.385.029.6 **1952**

Report of Advances in Microwave Theory and Techniques—1954.—D. D. King. (*Trans. Inst. Radio Engrs*, April 1955, Vol. MTT-3, No. 3, pp. 4–7.) A review of guided-wave transmission and the circuit aspects of microwave generators and amplifiers, comprising a classified bibliography of 167 items.

621.372.43 **1953**

The Optimum Tapered Transmission-Line Matching Section.—R. E. Collin. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 539–548.) The matching section is analysed as for a high-pass filter. The results obtained previously for the n-section $\lambda/4$ transformer (1250 of 1955) are adapted by allowing n to become infinite; theory developed in relation to aerial design [984 of April (Taylor)] is used. The optimum taper determined yields a matching section 13·9% shorter than the exponential taper and 27% shorter than the Gaussian taper for the same cut-off frequency and pass-band tolerance.

621.372.8 **1954**

A New Annular Waveguide Rotary Joint.—K. Tomiyasu. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 548–553.) A description is given of a joint designed to permit multiple stacking on a common axis. The joint will carry high power and permit operation with low s.w.r. and low insertion loss throughout the full rotation. Theory and performance characteristics are included.

621.372.8: 512.3 **1955**

Paired Systems of Infinite Linear Algebraic Equations, linked with Infinite Periodic Structures.—Ya. N. Fel'd. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1956, Vol. 106, No. 2, pp. 215–218. In Russian.) The method developed is applied to determine the currents in a rectangular waveguide containing an infinite array of transverse rods.

621.372.8: 621.318.134 **1956**

Propagation in a Ferrite-Filled Waveguide.—L. G. Chambers. (*Quart. J. Mech. appl. Math.*, Dec. 1955, Vol. 8, Part 4, pp. 435–447.) "Perturbation methods are used for the solution of the fields in a waveguide filled with ferrite material which is subjected to a static magnetic field in the direction of its axis. It is shown that quasi TE and quasi TM modes exist and the first terms in the expansion are calculated for the case of a waveguide of rectangular cross-section."

621.372.8: 621.318.134 **1957**

Some Applications and Characteristics of Ferrite at Wavelengths of 0·87 cm and 1·9 cm.—C. Stewart. (*Trans. Inst. Radio Engrs*, April 1955, Vol. MTT-3, No. 3, pp. 27–31.) The use of ferrites to produce Faraday rotation in waveguides is discussed and experimental results are presented, with details of the construction of a unidirectional waveguide for λ 0·87 cm. The improvement of the Dicke-type radiometer by use of devices based on this principle is described.

621.396.674.3 **1958**

Radiation Resistance of Dipoles in an Interface Between two Dielectrics.—J. R. Wait. (*Canad. J. Phys.*, Jan. 1956, Vol. 34, No. 1, pp. 24–26.) Exact expressions are derived for electric and magnetic dipoles located in a plane interface.

621.396.674.3: 621.396.11 **1959**

Transient Fields of a Vertical Dipole over a Homogeneous Curved Ground.—J. R. Wait. (*Canad. J. Phys.*, Jan. 1956, Vol. 34, No. 1, pp. 27–35.) Analysis is given first for the flat-earth case; the earth's curvature is then taken into account by means of appropriate modifications. When the aerial current is a linear function of time, the radiation field on a flat perfectly conducting earth is of step-function form; departures from this form are caused by the finite conductivity and dielectric constant of the ground, the induction and static fields of the aerial, and the earth's curvature, the last-named factor becoming effective at distances $>$ 50 km.

621.396.677.3 **1960**

The Optimum Current and Field Distribution for Broadside and End-Fire Radiators with Continuous Illumination.—A. Heilmann. (*Nachrichtentech. Z.*, Jan. 1956, Vol. 9, No. 1, pp. 1–9.) A method is presented for calculating the distribution of illumination to obtain maximum side-lobe attenuation for given beam width. The distribution function is built up from a limited number of terms of a Fourier series. The required number of terms and the beam width increase as the requirements for side-lobe attenuation become greater. With three terms, an attenuation $>$ 70 dB can be attained with a broadside array and $>$ 80 dB with an end-fire array.

621.396.677.3.029.62 **1961**

***LONG* Long Yagis.**—J. A. Kmosko & H. G. Johnson. (*QST*, Jan. 1956, Vol. 40, No. 1, pp. 19–24.) An experimental investigation of the characteristics of Yagi arrays for 2 m λ is reported; results for arrays comprising up to 68 elements are presented graphically. Constructional details are also given.

621.396.677.7 **1962**

The Phase Centre of Aperture Radiators.—K. Baur. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 541–546.) Calculations are based on Kirchhoff's aperture field method. Simplifications are introduced enabling the problem to be dealt with by means of tabulated functions. An approximate formula useful in practice is given. Results are compared with values obtained by measurements on horn radiators.

621.396.677.7 **1963**

Two New Modifications for Microwave Aerials.—G. von Trentini. (*Rev. telegr. Electronica, Buenos Aires*, Dec. 1955, Vol. 44, No. 519, pp. 715–718.) Constructional details and performance figures are presented for simple designs of (*a*) pyramidal horns with good directivity and gain, using trolitul masks for the counter-phase Fresnel zones in the aperture, and (*b*) wide-band aerials for circular polarization, using dielectric rods in circular waveguides.

621.396.677.8 **1964**

Passive Reflectors for Radio Beams (Experimental Investigation).—G. Andrieux. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 57–72.) Experiments based on theoretical work by Jakes (1243 of 1953) were carried out on a wavelength of 1·25 cm. Auxiliary tests proved that the results were applicable to an installation for 8·75 cm λ. The performance of a given

radio link is not appreciably affected by the use of a reflector system; risk of increased coupling between neighbouring aerials does exist, but can be overcome.

621.396.677.859 **1965**

Design of Radomes.—L. Thourel & S. Herscovici. (*Ann. Radioélect.*, April 1955, Vol. 10, No. 40, pp. 163–173.) Formulae developed previously [651 of 1950 (Cady et al.)] are extended to deal with multiple sandwich constructions. Simple methods of calculation are presented, together with experimental results.

AUTOMATIC COMPUTERS

681.142 **1966**

A Mechanical Binary-Decimal Converter.—M. Setterwall. (*J. sci. Instrum.*, Jan. 1956, Vol. 33, No. 1, pp. 18–19.)

681.142 **1967**

An Electronic Generator for Functions of Two Independent Variables.—V. Wentzel. (*Ericsson Tech.*, 1955, Vol. 11, No. 2, pp. 183–225.) A unit built at the Chalmers University of Technology is described. The function is recorded on a photographic plate in the form of variable-width columns; these are scanned by a c.r. tube. The output is either in the form of width-modulated pulses or in the form of a voltage proportional to the function.

681.142: 519.272: 534.6 **1968**

Measurement of Correlation Coefficient.—S. G. Gershman & E. L. Feinberg. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 326–338.) The determination of the correlation coefficient of a.f. noise is based on the measurement of the coincidences of sign of rectangular pulses triggered by the incoming signals. The instrument is described in detail and the theory of operation is given. See also 2542 of 1955 (Goff).

681.142: 621.3: 620.16 **1969**

Shock Spectrum Computer for Frequencies up to 2 000 c/s.—C. T. Morrow & D. E. Riesen. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 93–101.) An arrangement for investigating the effects of mechanical shock on electronic equipment installed e.g. in guided missiles comprises an analogue computer which operates on an accelerometer signal, either direct or recorded, and solves the differential equation for the part involved, the result being displayed on a c.r.o. screen. The computer can be tuned up to 2 kc/s, thus covering the range within which the fundamental resonance of any delicate structure is likely to occur.

681.142: 621.314.7 **1970**

Transistor Digital Computers.—(*Wireless World*, May 1956, Vol. 62, No. 5, pp. 210–212.) A brief account is given of circuit techniques involving the use of transistors and ferrite two-state storage devices described at the I.E.E. convention on digital computers held in London in April 1956.

681.142: 621.318.5: 537.312.62 **1971**

The Cryotron—a Superconductive Computer Component.—Buck. (See 1980.)

681.142: 621.387 **1972**

The Gas-Filled Diode as a Digital Storage Element.—B. R. Taylor & R. Bird. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 151–155.)

681.142 **1973**

Proceedings of the Eastern Joint Computer Conference. [Book Review]—Publishers: The American Institute of Electrical Engineers, New York, 92 pp., $3.00. (*Brit. J. appl. Phys.*, Jan. 1956, Vol. 7, No. 1, p. 41.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011.2 **1974**

Parallel-Connected Nonlinear Impedances.—S. Mayr. (*Elecktrotech. u. Maschinenb.*, 15th Jan. 1956, Vol. 73, No. 2, pp. 31–38.) Analysis based on a matrix method of representing complex vectors (847 of March) and locus diagrams are used to determine the equivalent single impedance for an arbitrary system of parallel impedances; values of voltage resulting from given current loads and of current resulting from given applied voltages are hence derived. The methods are illustrated by a numerical example taking two nonlinear impedances with ohmic resistance components. The complete working diagram of the parallel system is obtained by combining the locus diagram with the *I/V* characteristic.

621.314.2 + 621.318.43 **1975**

Subminiature Transformers and Transductors.—E. F. Dunkin & D. L. Johnston. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 144–150.) Limitations associated with subminiature design are discussed in relation to audio and control-frequency transformers and transductors. Below a certain size, a toroidal-shell construction has given results comparing favourably with laminated assemblies; the signal-power level of the transformers is sufficient for junction-transistor circuits. When this construction is applied to transductors, the excitation and control field are orthogonally related. A paper covering much of the same ground appears in *Trans. Inst. Radio Engrs*, April 1955, No. PGCP-3, pp. 30–44.

621.314.213 **1976**

Transformer 'Miniaturization' using Fluorochemical Liquids and Conduction Techniques.—L. F. Kilham, Jr, & R. R. Ursch. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 515–520.)

621.316.825 **1977**

The Stability of Thermistors.—A. Beck. (*J. sci. Instrum.*, Jan. 1956, Vol. 33, No. 1, pp. 16–18.) Experimental results indicate that though the constants of two thermistors tested undergo changes over a period of months, the changes are slow enough for temperature measurements to be made to an accuracy within 0·02°C over a range of 10°C in experiments lasting up to 24 h.

621.318.4.002.2 **1978**

Design of Modern Winding Machines.—(*TSF et TV*, Jan. 1956, Vol. 32, No. 327, pp. 10, 15.) A short review in which U.S. and European methods are contrasted.

621.318.5 **1979**

Transfer Function of Relays with Inactive Zone and Hysteresis.—R. Setton. (*C. R. Acad. Sci., Paris*, 27th Feb. 1956, Vol. 242, No. 9, pp. 1138–1140.) The equation of transfer for the relay is calculated by the Laplace-transform method.

621.318.5: 537.312.62: 681.142 **1980**

The Cryotron—a Superconductive Computer Component.—D. A. Buck. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 482–493.) "The study of nonlinearities in nature suitable for computer use has led to the cryotron, a device based on the destruction

of superconductivity by a magnetic field. The cryotron, in its simplest form, consists of a straight piece of wire about one inch long with a single-layer control winding wound over it. Current in the control winding creates a magnetic field which causes the central wire to change from its superconducting state to its normal state. The device has current gain, that is, a small current can control a larger current; it has power gain so that cryotrons can be interconnected in logical networks as active elements. The device is also small, light, easily fabricated, and dissipates very little power."

621.318.57 : 621.374.3 : 621.387 **1981**

Batching and Counting using Gas-Filled Decade Tubes.—W. Grimmond & W. H. P. Leslie. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 138–143.) A range of units is described from which a variety of frequency meters, batching counters, etc. can be quickly assembled; circuit diagrams are given.

621.319.4 **1982**

The Impedance of Shorted-Edge Wound Capacitors.—H. Heywang. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 29–44.) Results on the frequency variation of the impedance of this type of capacitor, obtained by Leiterer (449 of 1944), are discussed, using simple mathematics. The analysis is given first neglecting losses and is then extended to take account of losses in the dielectric and in the thin metal films. Eddy currents in the projecting contact layer and in thicker metal foils are also taken into account. The method is used to determine the transfer impedance of lead-through capacitors.

621.319.45 **1983**

The Forming of the Negative Electrode of Electrolytic Capacitors.—T. Bohlin & Å. Lagercrantz. (*Ericsson Tech.*, 1955, Vol. 11, No. 2, pp. 263–278.) An examination is made of the conditions under which undesired forming occurs; formulae are presented for the decrease of the capacitance on repeated discharging; these enable load behaviour to be predicted and optimum design to be attained. The theory is supported by experimental results.

621.372 : 621.314.7 **1984**

Principles of Transistor Circuits.—J. P. Vasseur. (*Ann. Radioélect.*, April 1955, Vol. 10, No. 40, pp. 99–162.) A comprehensive review covering amplifiers, oscillators and flip-flops. Over 70 references.

621.372.012 **1985**

Tolerance Limits in Matching.—W. Alexander. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 162–164.) Curves are given showing the level of power transfer from source to load for various degrees of mismatch.

621.372.029.6 + 621.385.029.6 **1986**

Report of Advances in Microwave Theory and Techniques—1954.—King. (See 1952.)

621.372.5 **1987**

Impedance Synthesis without Minimization.—A. Fialkow & I. Gerst. (*J. Math. Phys.* Oct. 1955, Vol. 34, No. 3, pp. 160–168.) The synthesis procedure described for realizing $Z(p)$, a rational positive real function of the complex-frequency variable p, by means of a network containing no mutual inductances, is performed in three steps in which the computationally difficult minimization process is avoided.

621.372.5 **1988**

The Geometrical Representation of Combined Linear Quadripoles.—J. de Buhr. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 561–570.) Concepts of non-Euclidean geometry are used. The representation of reactance quadripoles by a rigid system of two straight transformation lines and the determination of impedance transformations from geometrical reflections afford useful methods for treating composite quadripoles.

621.372.5 **1989**

The Geometrical Quadripole Representation of the Double Transformer.—J. de Buhr. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 45–49.) The representation is effected by adapting the technique described previously (1643 of June).

621.372.5.011.1 **1990**

The Operating-Parameter Cascade Matrix of Quadripoles.—F. L. Bauer. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 559–560.)

621.372.54 : 621.372.8 : 537.226 **1991**

Waveguide Filters.—M. H. N. Potok. (*Wireless Engr*, April 1956, Vol. 33, No. 4, pp. 79–82.) Filters having high Q and low insertion loss are produced by arranging inside a waveguide a number of suitably spaced dielectric sections constituting $\lambda/4$ transformers.

621.372.543.2 **1992**

Band-Pass Characteristics of Low Asymmetry.—B. Easter. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 156–158.) An empirical design procedure is formulated, leading to filter networks which compare favourably with conventional designs.

621.372.543.3 : 621.397.62 : 535.623 **1993**

New Rejector Circuit.—W. T. Cocking. (*Wireless Engr*, April 1956, Vol. 33, No. 4, pp. 77–79.) A circuit used in some colour television receivers [1882 of June (Fairhurst)] is described. It uses a conventional parallel-LC trap connected into circuit via a centre-tapped bifilar-wound coil with a resistance across one half; it is characterized by negative inductance and capacitance. The circuit is discussed further in *ibid.*, May 1956, Vol. 33, No. 5, pp. 105–107.

621.372.56.029.6 : 621.372.8 : 621.318.134 **1994**

A Double-Slab Ferrite Field Displacement Isolator at 11 kMc/s.—S. Weisbaum & H. Boyet. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 554–555.) Brief description, with performance figures, of an isolator comprising a waveguide with two slabs of ferrite arranged with transverse symmetry and subjected to equal but oppositely directed magnetic fields; the forward loss is < 1 dB over most of the range from 10·7 to 11·7 kMc/s, and varies by $< 0{\cdot}1$ dB over any 20-Mc/s channel, while the reverse loss is 64–70 dB. See also 972 of 1955 (Lax et al.).

621.372.6 **1995**

Impedance Transformation of Linear $2n$-Terminal Networks.—H. Kleinwächter. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 26–28.) If $(n-2)$ outlets of a $2n$-terminal network are terminated by variable reactances, the resulting quadripole represents a variable transformer. As the value of these reactances varies between $-j\infty$ and $+j\infty$, the input impedance assumes all values of the transforming range. This range does not include the entire right-hand half of the complex impedance plane, but only circular areas thereof. An equation is derived for determining these circles. The method is demonstrated in relation to a waveguide hybrid-T.

621.373 **1996**

Fluctuations in Self-Oscillating Systems of Thomson Type.—S. M. Rytov. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3(9), pp. 304–328.) Amplitude and phase fluctuations in weakly nonlinear self-oscillating systems are considered, using a symbolic differential equation describing the fluctuations of the random functions and the methods of the correlation theory. A system with one degree of freedom is considered first and the general theory is applied to the case of a valve generator operating in the 'soft' state. The theory is then applied to passive systems with one and two degrees of freedom. The effect of stabilizing the frequency of an oscillator by means of a high-Q circuit is discussed. The method of taking into account thermal fluctuations is shown.

621.373.4.029.6: 621.396.822 **1997**

Fluctuation of Oscillations of Klystron Generator.—I. L. Pershtein. (*C. R. Acad. Sci. U.R.S.S.*, 21st Jan. 1956, Vol. 106, No. 3, pp. 453–456. In Russian.) A theoretical investigation of noise in a reflex klystron is presented. In a typical case the natural bandwidth of the oscillations is 0·1 c/s; the results obtained by Shimoda (2943 of 1953) are believed to be in error.

621.373.42 **1998**

Frequency of the Three-Phase *RC* Coupled Oscillator: Part I—Non-reactive Anode Load Resistance.—H. Rakshit & M. C. Mallik. (*Indian J. Phys.*, Nov. 1955, Vol. 29, No. 11, pp. 534–547.) Report of an investigation of the effect of different types of cathode impedance on the oscillation frequency.

621.373.43: 621.314.7 **1999**

Application of Junction Transistors to the Generation of Linear Sawtooth Waveforms.—(*Mullard tech. Commun.*, Dec. 1955, Vol. 2, No. 16, pp. 134–139.)

621.373.44 **2000**

Two Trigger Circuits Useful as Sources of Rectangular Pulses.—G. G. E. Low. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 158–159.) A modified Eccles-Jordan circuit having low output impedance and a development of Schmitt's cathode-coupled trigger circuit are presented.

621.375: [621.314.7 + 621.385 **2001**

Comparison of Junction Transistor and Amplifier Valve.—G. Ledig. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 1–9.) The quadripole equations are developed for the commonly used circuits; important parameters and relations are tabulated. For linear operation the valve can be regarded from the network point of view as a simplified limiting case of the class containing both valves and transistors.

621.375.221.2 **2002**

Analysis of a Regenerative Amplifier with Distributed Amplification.—B. S. Golosman. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 533–534.) Analysis indicates that the application of distributed amplification in regenerative circuits, such as the monostable multivibrator, is limited by its inherent time delay.

621.375.23 **2003**

Component Tolerance Effects in Feedback I.F. Amplifiers.—H. S. Jewitt. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 165–167.) Analysis relating to T and Π feedback networks is given. Resistor variation produces no asymmetry of the response curve; in this respect the feedback i.f. amplifier (1009 of 1954) is superior to the stagger-tuned amplifier.

621.375.232.3.024 **2004**

A Direct-Current Amplifier Stage with Asymmetrically Earthed Input.—E. G. Schlosser & S. Götze. (*Frequenz*, Jan. 1956, Vol. 10, No. 1, pp. 19–24.) A push-pull cathode-follower circuit is used, with two valves having dissimilar characteristics and a special resistance coupling, the usual phase-reversing stage being omitted. Analysis is presented on the basis of a parabolic approximation to the characteristics. Design procedures for ensuring the requisite quiescent-current and linearity conditions are indicated. A numerical determination is made of the operating point for a circuit using one Type-EL90 and one Type-EL32 valve.

621.376.22: 621.318.134 **2005**

A Note on Sidebands produced by Ferrite Modulators.—P. A. Rizzi & D. J. Rich. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, p. 556.)

621.376.23: 621.385.029.6 **2006**

Microwave Detector.—Mendel. (See 2259.)

621.376.332.029.6: 621.372.413 **2007**

A Simple Microwave Discriminator.—C. Colani. (*Frequenz*, Jan. 1956, Vol. 10, No. 1, pp. 25–26.) A cylindrical resonator with slightly disturbed symmetry has two closely spaced resonance frequencies for the H_{11} mode, corresponding to two waves with slightly different propagation velocities. These can be detected separately, by means of rectifiers. A discriminator characteristic is given by the difference of the rectified currents as a function of frequency. The dimensions of the resonator for a given frequency can be reduced by capacitive loading. Discriminators of this type are suitable for measurement and control purposes rather than for demodulating f.m.

621.39.03 **2008**

Miniaturization and Quality Improvement of Circuit Parts.—T. Nijo. (*Rep. elect. Commun. Lab., Japan*, Aug. 1955, Vol. 3, No. 8, pp. 22–28.) Coils, transformers, resistors, capacitors, quartz-crystal units and filters developed by the Nippon Telegraph and Telephone Public Corporation are described and illustrated.

621.397.6.001.4 **2009**

Circuit Technique for Generation of Electrical Test Patterns in Television.—Pilz. (See 2231.)

GENERAL PHYSICS

53.05 **2010**

A Method of analysing Periodicity.—F. Mosetti. (*Ann. Geofis.*, July 1955, Vol. 8, No. 3, pp. 331–349.) A method of analysing an empirical function such as that corresponding to the record of an oscillation process is based on asymmetrical rather than symmetrical linear combinations of ordinates; it permits detection of variations of phase as well as amplitude.

530.145: 535.14 **2011**

Theory of Radiation.—J. C. Gunn. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 127–183.) A survey of the application of quantum field theory to the interaction between charged particles and the electromagnetic field; within this domain it is now possible to calculate any process with a precision only limited by the labour of the calculations. About 60 references.

534.01 **2012**

Intensity of Harmonic and Combination Components in the Nonlinear Distortions of Complex Oscillations.—V. M. Vol'f. (*Akust. Zh.*, Oct.–Dec.

1955, Vol. 1, No. 4, pp. 321–325.) The effect of linear, quadratic and cubic response characteristics on triangular, saw-tooth and rectangular signals is considered; results are tabulated.

535.34 : 537.56 : 546.17 **2013**

Ultraviolet Absorption of Atomic Nitrogen in its Ionization Continuum.—A. W. Ehler & G. L. Weissler. (*J. opt. Soc. Amer.*, Dec. 1955, Vol. 45, No. 12, pp. 1035–1043.) The absorption of radiation of 400–800 Å λ by the plasma of a discharge in an ionization gauge was measured by passing the transmitted radiation into a spectrograph. Various considerations indicate that the absorption is due to atomic nitrogen, the absorption cross-section of which is hence deduced.

537.1 **2014**

The Physical Interpretation of the Self-Acceleration of Electrons.—K. Wildermuth. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 450–459.) The forces governing the motion of electrons are most easily understood if the point electron is considered as the limiting case of the finite-size electron. For self-acceleration to occur, it is not essential that the e.m. field energy be infinite, but it is important that the mechanical mass of the electron be negative.

537.122 **2015**

Measurement of the Specific Charge of Conduction Electrons.—V. M. Yuzhakov. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3 (9), pp. 388–390.) The theory of a method of determining e/m by means of a special dynamo is given. The device comprises a pair of concentric coils which together rotate with angular velocity ω, about an axis parallel to the applied magnetic field. The rectangular inner coil can also rotate about its own axis, which is perpendicular to the magnetic field. The two resulting e.m.fs in the inner coil are due to (*a*) induction and (*b*) Coriolis force acting on the conduction electrons. If these e.m.fs are equal then $e/m = 2c\omega/H$, where c is the velocity of light and H the magnetic-field strength. The estimated experimental errors are not greater than 1%.

537.2 **2016**

Potential due to a Uniformly Charged Disk.—É. Durand. (*C. R. Acad. Sci., Paris*, 13th Feb. 1956, Vol. 242, No. 7, pp. 887–889.) Formulae are derived applicable to any point.

537.311 **2017**

The Effect of Free Electrons on Lattice Conduction.—J. M. Ziman. (*Phil. Mag.*, Feb. 1956, Vol. 1, No. 2, pp. 191–198.) "The scattering of phonons by electrons is calculated, assuming the usual electron-phonon interaction, for a parabolic band whose degeneracy temperature is comparable with the temperature of the lattice. The contribution to the thermal resistance is given by an exact formula, subject only to justifiable assumptions concerning phonon-phonon interactions. With rising temperature the apparent mean free path of the phonons at first decreases as $1/T$ (or, if there are very few electrons, as $\exp a/T$), but reaches a minimum and then increases as T^2. Energy and momentum conservation then allow only the tail of the electron distribution to contribute to the scattering. The model is thought to apply to certain observations on *p*-type germanium, irradiated sapphire and conducting diamond."

537.5 **2018**

Ionization by Relativistic Particles.—B. T. Price. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 52–82.) A summary is given of theories of the relativistic increase of energy loss by ionization and of the density effect. The experimental evidence, as obtained with various types of counter, is discussed and compared with theoretical predictions. Over 100 references.

537.5 **2019**

The Ionization and Dissociation of Complex Molecules by Electron Impact.—J. D. Craggs & C. A. McDowell. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 374–422.) A review covering theoretical and experimental aspects of collision processes in polyatomic molecular gases. Over 100 references.

537.525 : 537.534 **2020**

Ion Oscillations in a Cathode Potential Minimum.—K. G. Emeléus & N. R. Daly. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 114–115.) A brief theoretical note.

537.525 : 538.569.029.6 : 538.6 **2021**

The Rotation of Plasmoids in a Magnetic Field.—H. Pupke & H. G. Thom. (*Naturwissenschaften*, Jan. 1956, Vol. 43, No. 2, p. 32.) The motion of a luminous low-pressure gas discharge in Ne in the presence of a magnetic field and a superposed r.f. field of frequency about 75 Mc/s was found to be a function of the anode voltage of the output valve of the 1-kW r.f. generator used.

537.528 **2022**

Formative Time Lags in the Electric Breakdown of Liquid Hydrocarbons.—R. W. Crowe. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, pp. 156–160.)

537.533 **2023**

The Work Function and Patch Field of an Irregular Metal Surface.—M. J. Morant & H. House. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 14–20.) Calculations show that the lowering of the work function due to irregularities of the surface is entirely compensated by a patch field.

537.56 : 538.569.029.4/.6 **2024**

The Breakdown of Gases subject to Crossed Electric Fields.—W. A. Prowse & P. E. Lane. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 33–46.) The effect of an auxiliary electric field, acting at right angles to a 10-kMc/s field, on the breakdown stress of various gases is investigated experimentally. When the auxiliary field is unidirectional or of relatively low frequency (0·86 Mc/s) its application raises the breakdown stress, but when its frequency reaches 9·7 Mc/s the two fields appear to act independently. A partial explanation is advanced. The gases studied include air, oxygen, nitrogen, hydrogen and neon.

538.114 **2025**

Spin-Deviation Theory of Ferromagnetism: Part 2—The Non-ideal Spin-Deviation Gas.—J. Van Kranendonk. (*Physica*, Dec. 1955, Vol. 21, No. 12, pp. 925–945.) Part 1: 1368 of May.

538.114 **2026**

Application of the Bethe-Weiss Method to Ferrimagnetism.—J. S. Smart. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 585–591.)

538.3 **2027**

Classical Electrodynamics as a Distribution Theory.—J. G. Taylor. (*Proc. Camb. phil. Soc.*, Jan. 1956, Vol. 52, Part 1, pp. 119–134.)

538.3 : 535.13 **2028**

A Derivation of Generalized Microscopic Electrodynamic Equations: Part 1—Non-relativistic.—B. Podolsky & H. Denman. (*J. Math. Phys.*, Oct. 1955, Vol. 34, No. 3, pp. 198–207.) Maxwell's equations and

the constitutive relations are derived from the classical microscopic theory, without making use of extensive assumptions, so that the effects of the higher-order electric and magnetic moments are retained in the equations.

538.56 : 537.56 **2029**

On the Theory of Stationary Waves in Plasmas.—N. G. Van Kampen. (*Physica*, Dec. 1955, Vol. 21, No. 12, pp. 949–963.) A mathematical treatment is presented appropriate to the case of a continuous non-vanishing distribution of particle velocities. A complete set of stationary-plane-wave solutions can be constructed. There is no dispersion equation because for a given wave vector a continuous range of values of frequency is possible.

538.566 : 537.56 **2030**

Growing Electromagnetic Waves.—J. H. Piddington. (*Phys. Rev.*, 1st Jan. 1956, Vol. 101, No. 1, pp. 9–14.) The growth of e.m. waves is considered in terms of Bailey's electromagneto-ionic theory (see e.g. 105 of 1952). Of the 12 different wave modes predicted by this theory, four are unreal; the remainder comprise two pairs of hydromagnetic waves which become pure e.m. waves at a sufficiently high frequency, one pair of modified sound waves, and one pair of modified electron-sound waves. The growth of the e.m. waves may result from the trappings of ions between potential troughs of the space-charge wave and the subsequent surrender of energy by the ions. Ion drifts may introduce important effects not indicated by the wave equations.

538.566 : 538.221 : 538.6 **2031**

Theory of Wave Propagation in a Gyromagnetic Medium.—P. S. Epstein. (*Rev. mod. Phys.*, Jan. 1956, Vol. 28, No. 1, pp. 3–17.) The theory presented is relevant to propagation in ferrites, but the physical nature of ferrites is not discussed.

538.569.4 **2032**

On the Absorption of 3·18-cm Microwaves in some Substituted Phenols in the Liquid State.—D. K. Ghosh. (*Indian J. Phys.*, Dec. 1955, Vol. 29, No. 12, pp. 581–586.)

538.569.4 : 538.221 **2033**

Possible Source of Line Width in Ferromagnetic Resonance.—A. M. Clogston, H. Suhl, L. R. Walker & P. W. Anderson. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 903–905.) Brief theoretical discussion indicating the effect of the finite size of a sample on the dispersion of relaxation times.

539.1 : [537.311.31 + 537.311.33 **2034**

The Displacement of Atoms in Solids by Radiation.—G. H. Kinchin & R. S. Pease. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 1–51.) A survey covering theoretical and experimental aspects of the irradiation of solids by particles or γ rays; effects produced in metals and semiconductors are described. Nearly 200 references.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **2035**

Halo of Radio Emission and the Origin of Cosmic Rays.—G. R. Burbridge. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 906–907.) Observations of r.f. radiation from nebulae [e.g. 104 of 1955 (Baldwin)] indicate that a large fraction of the radiation comes from roughly spherical regions centred on the galactic centre and having radii of about 15 kiloparsecs. The particle density and energy conditions in these regions are considered in relation to the acceleration of cosmic rays.

523.16 : 523.45 **2036**

A Search for Radiation from Jupiter at 38 Mc/s and at 81·5 Mc/s.—F. G. Smith. (*Observatory*, Dec. 1955, Vol. 75, No. 889, pp. 252–254.) Following the observation of radiation from Jupiter at 22 Mc/s [2933 of 1955 (Burke & Franklin)], records obtained at Cambridge, England, of radiation received at 38 Mc/s and 81·5 Mc/s were searched for evidence of radiation from Jupiter at these frequencies; results were negative. Inferences are drawn regarding the source of radiation on Jupiter.

523.5 : 621.396.96 **2037**

Characteristics of Radio Echoes from Meteor Trails: Part 2—The Distribution of Meteor Magnitudes and Masses.—I. C. Browne, K. Bullough, S. Evans & T. R. Kaiser. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 83–97.) The distributions are deduced from observations of sporadic meteors and various showers. Part 1 : 2782 of 1948 (Lovell & Clegg).

523.5 : 621.396.96 **2038**

Characteristics of Radio Echoes from Meteor Trails: Part 4—Polarization Effects.—E. R. Billam & I. C. Browne. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 98–113.) The theoretical estimates of plasma resonance effects by Kaiser & Closs (2208 of 1952) were tested at a frequency of 55·3 Mc/s. The polarization effects observed are in good agreement with the predictions for both short- and long-duration echoes, but some unexpected results were obtained for meteor trails with line densities in the transition region of 10^{12} electrons/cm. The echo amplitude A was found to be proportional to $T^{0\cdot3}$ instead of the predicted $T^{3/16}$, where T is the duration of the echo. The discrepancy may be the result of diffusion by turbulence in the atmosphere. Part 3 : 2493 of 1952 (Greenhow).

523.5 : 621.396.96 **2039**

Meteor Echo Durations and Visual Magnitudes.—P. M. Millman & D. W. R. McKinley. (*Canad. J. Phys.*, Jan. 1956, Vol. 34, No. 1, pp. 50–61.) The statistical relation between the radio-echo duration and the visual magnitudes was analysed using observations obtained during the years 1948–1950 on about 3300 meteors. Over a range of magnitudes the relation is linear or nearly linear. It is inferred that a meteor of absolute magnitude + 5 produces 2×10^{19} electrons per cm of path length.

523.5 : 621.396.96 **2040**

Radar-Echo Duration and Height of a Perseid Meteor.—D. W. R. McKinley. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 76–82.) Triangulation data for a meteor echo lasting 549 sec, observed on 12th August 1948, are discussed.

523.7 **2041**

Daily Maps of the Sun.—P. A. Wayman. (*Nature, Lond.*, 17th March 1956, Vol. 177, No. 4507, pp. 518–519.) A brief note announcing the inauguration of a service in which a number of observatories are co-operating to produce comprehensive records of solar phenomena.

523.75 : 550.385 **2042**

Solar Corona and Geomagnetism.—M. Notuki, Y. Nakagomi & M. Fukatsu. (*Rep. Ionosphere Res. Japan*, Dec. 1955, Vol. 9, No. 4, pp. 215–221.) Both coronal activity and geomagnetic disturbance vary directly with general solar activity except at the period of sunspot minimum, when correlation between the two is negative. Geomagnetic disturbance is greatest when the earth is in the radial line of an active coronal centre. An active centre appears to have a shielding effect on the outflow of corpuscles from the undisturbed solar areas.

523.78: 523.72.029.6 **2043**

A Model for the Solar Enhanced Region at Centimeter Range derived from Partial Eclipse Observations.—T. Hatanaka, K. Akabane, F. Moriyama, H. Tanaka & T. Kakinuma. (*Rep. Ionosphere Res. Japan*, Dec. 1955, Vol. 9, No. 4, pp. 195–204.) Records taken at three Japanese observatories on frequencies between 3 and 4 kMc/s during the partial eclipse of the sun on 20th June 1955 show a marked decrease on the observed flux during the period when a large sunspot group was eclipsed; the location, size and brightness distribution of the enhanced-radiation region are derived. A model for the quiet sun, having a bright region near the limb on the equator is also suggested.

550.385 **2044**

S_q-Field in the Polar Region on Absolutely Quiet Days.—T. Nagata & H. Mizuno. (*J. Geomag. Geoelect.*, Sept. 1955, Vol. 7, No. 3, pp. 69–74.) Analysis of data for the Second Polar Year indicates that the S_q field, which is recognized as applying to the region between latitudes 60°N and 60°S, also represents the daily variation in the geomagnetic field over the rest of the earth for absolutely quiet days.

550.358: 523.78 **2045**

Report of Observations of Geomagnetic Variations at Aso and Naze (Amami-Oshima), during the Solar Eclipse of June 20th, 1955.—M. Ota, H. Maeda, H. Yasuhara & S. Hashizume. (*J. Geomag. Geoelect.*, Sept. 1955, Vol. 7, No. 3, pp. 86–90.)

551.510.53: 534.22 **2046**

Introductory Theory for Upper Atmosphere Wind and Sonic Velocity Determination by Sound Propagation.—G. V. Groves. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 24–38.) Theory applicable to a rocket-grenade experiment is developed.

551.510.534 **2047**

The Atmospheric Ozone as Indicator of Air Streams in the Stratosphere: Part 1—The Photochemical Bases.—H. U. Dütsch. (*Arch. Met. A, Wien*, 1st Dec. 1955, Vol. 9, No. 1, pp. 87–119.)

551.510.535 **2048**

A Method of determining the Relative Amounts of D- and E-Region Absorptions of Medium and Short Radio Waves.—A. P. Mitra. (*Indian J. Phys.*, Nov. 1955, Vol. 29, No. 11, pp. 518–521.) The method is based on the concept of 'relaxation time' [3289 of 1953 (Appleton)], the value of which for the D layer is appreciably different from that for the E layer.

551.510.535 **2049**

Region E and the S_q Current System.—W. J. G. Beynon & G. M. Brown. (*Nature, Lond.*, 24th March 1956, Vol. 177, No. 4508, pp. 583–584.) The complete equilibrium equation for the electron density in a solar-controlled ionospheric region includes a term which depends on vertical drift and is usually neglected; the E-layer critical frequency f_E is then related to the zenith angle χ by the equation $(f_E)^n = K \cos \chi$, where K is a constant and, for an isothermal region, n has the value 4 for recombination and 2 for attachment. Values of n deduced from actual observations lie between 2 and 4; these findings are discussed on the assumption that the variation of n results from neglect of the vertical-drift term. The theory is supported by observations of singularities in the noon curves of n/latitude for several longitudes; these singularities, corresponding to 'normal' values of f_E, coincide approximately with the position of the foci of the S_q current system.

551.510.535 **2050**

A New Method of analysing Ionospheric Movement Records.—G. L. Rogers. (*Nature, Lond.*, 31st March 1956, Vol. 177, No. 4509, pp. 613–614.) Technique based on optical diffraction systems is outlined. The ionosphere is provisionally assumed to be a plane reflector, and the image of a ground transmitter in it is regarded as a source of coherent radiation giving rise to a diffraction pattern on the ground corresponding to an inhomogeneity moving in or below the ionosphere. From the geometry of the system a focal length is deduced, and when the record of the diffraction pattern is converted into a variable-density photographic record a corresponding visual focal length is obtained, from which the velocity of the moving inhomogeneity can be determined. The method has been tried at the New Zealand Dominion Physical Laboratory, using aerials arranged at the corners of a triangle as suggested by Mitra (96 of 1950). Holograms showing some results are reproduced; from these it is clear that moving objects far below the ionosphere can affect the records significantly.

551.510.535 **2051**

Movements of Irregularities in the E Region: Part 2.—T. Obayashi. (*J. Radio Res. Labs, Japan*, Oct. 1955, Vol. 2, No. 10, pp. 413–417.) Continuing the work referred to in 418 of February, results for the period July 1954–March 1955 show that an east wind with an average velocity of 80 m/sec predominates in the evening, continuing throughout the night in winter; towards sunrise winds in the reverse direction are frequent. Irregularities are estimated to be 100–200 km in extent.

551.510.535 **2052**

Sequential E_s and Lunar Effects on the Equatorial E_s.—S. Matsushita. (*J. Geomag. Geoelect.*, Sept. 1955, Vol. 7, No. 3, pp. 91–95.) Among the various types of E_s which have been observed, one shows apparent vertical movement on the ionogram, and has been termed 'sequential E_s' by investigators at the National Bureau of Standards. A study is made of this phenomenon using records from a number of stations; the subtype investigated is that involving an E_s region which first appears at a height of about 200 km in winter and 180 km in summer and then drops to normal E level, where it persists for some hours. The latitude and time distributions of the phenomenon are briefly discussed.

551.510.535 **2053**

On Anomalous Variations of Critical Frequencies and Virtual Heights of the F_1 and E regions of the Ionosphere.—T. Sato. (*Rep. Ionosphere Res. Japan*, Dec. 1955, Vol. 9, No. 4, pp. 205–214.) Latitudinal and seasonal variations of critical frequencies and virtual heights of the F_1 and E layers, for years of high and low sunspot activity, are investigated. Anomalous variations are found, analogous to those in the F_2 layer (3254 of 1955); similar explanations are suggested.

551.510.535 **2054**

The Diurnal and Annual Variations of F_1 Ionization. An Interpretation.—O. Burkard. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 83–90. In German.) Values of x and $\log C$ in the formula $(f_0F_1)^x = C^x (\cos \chi)^x$, calculated from C.R.P.L. records for 1934–1954, are tabulated. The variation of these values is discussed and a model is derived for F_1-layer conditions in which the temperature gradient is smaller in summer than in winter.

551.510.535 **2055**

A Study of the Total Electron Content of the F-Region of the Ionosphere over Ahmedabad (23°N, 72°38'E), India.—R. M. Sheriff. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 91–97.) The total number of electrons in a column of unit cross-section in the F_1 and F_2 regions up to the height h_p of maximum electron density has been calculated for three magnetically quiet and three disturbed days in each month from February 1953 to January 1954. The method of analysis is that suggested by Ratcliffe (1292 of 1952) assuming parabolic electron density distribution. The relation between the semi-thickness y_m and h_p for the F_2 layer shows that thick layers are associated with higher values of h_p and that the parabolic-distribution law does not hold for very thick layers.

551.510.535 **2056**

Determination of the F-Region Collisional Frequency (over Calcutta).—M. Ghosh. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 116–118.) The collision frequency ν reaches its maximum ($\sim 5 \times 10^3$/sec) at about noon, and its minimum ($\sim 10^2$/sec) at about midnight. The rate of rise of ν increases with $\cos \chi$.

551.510.535 **2057**

A Possible Explanation of the Drop in F-Region Critical Densities accompanying Major Ionospheric Storms.—M. J. Seaton. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 122–124.) An explanation in terms of increased recombination rates is suggested, based on evidence that the abundance of O_2 at great heights is governed by vertical transport [*Rocket Exploration of the Upper Atmosphere*, 1954, pp. 361–365 (Nicolet)].

551.510.535: 523.16 **2058**

The Spectrum of Radio-Star Scintillations and the Nature of Irregularities in the Ionosphere.—J. P. Wild & J. A. Roberts. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 55–75.) Simultaneous observations of the intense source in Cygnus were made with (*a*) a frequency-sweep spectroscope, (*b*) a frequency-sweep interferometer, and (*c*) a triangular spaced-aerial receiving system. Most fluctuations are due to focusing by single lens-like irregularities. The fluctuation amplitude shows two maxima: one near midnight (winter); the other near midday (summer). For day-time conditions at least, the elongation of the pattern at the ground indicates marked anisotropy in the ionosphere irregularities.

551.510.535: 523.746 **2059**

Correlation between Noon f_0F_2 and Sunspot Number.—J. M. Roy. (*J. Instn Telecommun. Engrs, India*, Dec. 1955, Vol. 2, No. 1, pp. 45–47.) Analysis of data from four Indian stations shows a linear relation between the running means of the sunspot number R and the noon value of f_0F_2, up to a limiting value of R.

551.510.535: 523.78 **2060**

Tilts in the Ionosphere during the Solar Eclipse of 30 June 1954.—E. N. Bramley. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 98–104.) "Directional measurements at nearly vertical incidence on the F layer during the eclipse showed the existence of a tilt whose direction agreed with that expected from the geometry of the eclipse. The magnitude of the tilt was also of the same order as that calculated from observed changes in the height of reflection. Oblique-incidence bearing measurements on signals reflected from the normal E layer failed to reveal any eclipse effect, and theoretical calculation showed that no detectably large effect would have been expected in this case."

551.510.535: 523.78 **2061**

Preliminary Results of the Ionospheric Solar Eclipse of 25 December 1954.—M. E. Szendrei & M. W. McElhinny. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 108–114.) An analysis of critical-frequency data obtained in Grahamstown during this annular eclipse. The effects may be explained to a first approximation by assuming that the radiation responsible for the ionosphere structure is distributed uniformly over the sun's disk. Values of recombination coefficient for the E_1, F_1 and F_2 layers are in good agreement with values obtained recently by independent methods.

551.510.535: 523.78 **2062**

Observations of the Lower Ionosphere during the Solar Eclipse on 30th June 1954.—K. Sprenger & E. A. Lauter. (*Gerl. Beitr. Geophys.*, 1955, Vol. 64, No. 4, pp. 284–312.) Propagation tests were made at Kühlungsborn on frequencies of 185 kc/s–1·223 Mc/s during the eclipse. The expected increase of reflection coefficient in the lower ionosphere was considerably delayed after first contact, and normal attenuation values were restored before the end of the eclipse. The magnitude of the effect (about 40 dB) and the delay of the maximum (about 4 min) agreed with predictions from normal diurnal and seasonal variations based on a single-layer model of the D layer, but the limited duration of the effect was consistent with a multilayer model. Observations of complex variations of very-long-wave atmospherics are also reported.

551.510.535: 550.38 **2063**

The Influence of the Geomagnetic Field on Turbulence in the Ionosphere.—J. W. Dungey. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 39–42.) E.m. damping of turbulent motion of neutral particles is negligible for the smaller eddies. In the higher regions electrons are constrained to move nearly parallel to the magnetic field; this results in variations of electron density, even when the density of neutral molecules does not vary. These variations may be appreciable above 100 km, e.g. $\sim 5\%$ at 110 km.

551.510.535: 550.385 **2064**

On the Disturbance Daily Variations and the Lunar Daily Variations in the F_2 Region of the Ionosphere on the Magnetic Equator.—H. Maeda. (*J. Geomag. Geoelect.*, Sept. 1955, Vol. 7, No. 3, pp. 75–85.) Continuation of work reported previously [e.g. 425 of February (Maeda et al.)] on the effects of vertical electron drift due to the electrical fields associated with the currents responsible for the diurnal geomagnetic variations.

551.510.535: 621.396.11 **2065**

D-E Layer Electron Model reduced from Considerations of M.F. and H.F. Wave Absorption.—Kobayashi. (See 2194.)

551.510.535: 621.396.11 **2066**

The *Z* Propagation Hole in the Ionosphere.—Ellis. (See 2195.)

551.510.535: 621.396.11 **2067**

The Interpretation of Measurements of Radio-Wave Interaction.—Huxley. (See 2197.)

551.543 **2068**

A Comparison of the Annual Mean Solar and Lunar Atmospheric Tides in Barometric Pressure, as regards their Worldwide Distribution of Amplitude and Phase.—S. Chapman & K. C. Westfold. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 1–23.)

551.594.221 : 551.508.94 **2069**

The Influence of Individual Variations in the Field Changes due to Lightning Discharges upon the Design and Performance of Lightning Flash Counters.—E. T. Pierce. (*Arch. Met. A, Wien*, 1st Dec. 1955, Vol. 9, No. 1, pp. 78–86. In English.) Flash counters responding only to the e.s. component of the field change are likely to be least subject to error; this implies a preferential selection of very low frequencies. Examples are given indicating the extent of the inaccuracies encountered. From statistics of rates of flashing and duration of discharges it is concluded that counters should have an insensitive period of about 1 sec. The design of counters is discussed and a simple circuit is presented.

551.594.6 **2070**

Low Audio-Frequency Electromagnetic Signals of Natural Origin.—R. E. Holzer & O. E. Deal. (*Nature, Lond.*, 17th March 1956, Vol. 177, No. 4507, pp. 536–537.) Signals in the frequency range 25–130 c/s have been recorded in California over long periods. The diurnal variation of signal amplitude closely resembles the diurnal variation of atmospheric potential gradients measured at sea; it is inferred that these low-frequency signals are atmospherics and that their mean amplitude is roughly proportional to the number of storms in progress over the whole world.

523.746 + 550.385 **2071**

Sunspot and Geomagnetic-Storm Data derived from Greenwich Observations 1874–1954. [Book Review]—Publishers: H. M. Stationery Office, London, 1955, 106 pp. 25s. (*Nature, Lond.*, 17th March 1956, Vol. 177, No. 4507, p. 499.) Includes explanatory notes and literature references and some diagrams.

LOCATION AND AIDS TO NAVIGATION

527.6 : 531.383 **2072**

Inertial Air Navigation Systems.—(*Tele-Tech & Electronic Ind.*, Jan. 1956, Vol. 15, No. 1, pp. 61 . . 122.) Systems are discussed in which the velocity and position of an aircraft at any time are determined by integrating the outputs of three accelerometers; a two-axis gyro device is used. No information is required from outside sources, and no detectable signal is radiated.

621.396.933 + 621.396.969 **2073**

Communication and Navigational Aids for the Bristol Britannia.—N. G. Anslow. (*Brit. Commun. Electronics*, Jan. 1956, Vol. 3, No. 1, pp. 6–9.) A brief description of the radio and radar installation in a modern long-range airliner is given.

621.396.96 **2074**

Radar Operation and Data Collection desired during Tornadoes and Other Severe Weather Conditions.—(*Bull. Amer. met. Soc.*, June 1955, Vol. 36, No. 6, pp. 289–291.) Procedures recommended by the Committee on Radar Meteorology of the American Meteorological Society are indicated.

621.396.96 : 621.396.662 **2075**

Radar A.F.C. System uses Mechanical Tuning.—J. L. Confalone & W. R. Rambo. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 138–141.) For searching, the radar receiver local oscillator is tuned to within a few Mc/s by a motor-driven system controlled by signals from the i.f. amplifier; the system then switches to a.f.c. action, effected by means of a discriminator controlling a two-phase motor. A bistable trigger circuit provides automatic switching between the two states. The complete circuit is shown.

621.396.963 **2076**

Clutter on Radar Displays.—J. Croney. (*Wireless Engr*, April 1956, Vol. 33, No. 4, pp. 83–96.) "An analysis is developed of the action of an idealized logarithmic receiver followed by a differentiating circuit (high-pass filter), upon inherent receiver noise, sea-clutter and rain-clutter echoes. The analysis is extended to estimate the extent to which the performance of the practical logarithmic receiver may depart from that of the idealized receiver. Results are given of experiments with logarithmic receivers on both S and X band radars. The loss which occurs when a differentiating circuit follows a logarithmic receiver is stated, the cause examined and a method of minimizing the loss suggested. The important design parameters of a logarithmic receiver for clutter reduction are dealt with." See also 2953 of 1954.

621.396.963 : 621.385.832 **2077**

Storage-Tube Device simulates Radar Net.—S. Shenfield & M. Finkle. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 181–183.) Signals in the form in which they would be received from two or more geographically separated stations are applied on a time-sharing basis to a storage-type cathode-ray tube provided with means for off-centring the beam in the X and Y directions. On reading out, the signals are separated and directed to individual indicator tubes corresponding to the individual stations.

MATERIALS AND SUBSIDIARY TECHNIQUES

533.5 + 544.4 **2078**

The Analysis of Gases at Low Pressures.—M. A. Cayless. (*Brit. J. appl. Phys.*, Jan. 1956, Vol. 7, No. 1, pp. 13–16.) Apparatus for handling gas in measured quantities of 10^{-6} cm³ and over at pressures down to 10^{-6} mm Hg, and for effecting analysis at pressures between 10^{-2} and 1 mm Hg is described.

535.37 : 546.41.33.185-85 **2079**

Modified Calcium Pyrophosphate Phosphors.—D. E. Kinney. (*J. electrochem. Soc.*, Dec. 1955, Vol. 102, No. 12, pp. 676–681.) The partial substitution of Na for Ca increases the luminescence efficiency.

535.37 : 546.472.21 **2080**

Some Optical Properties of New Zinc-Sulphide Phosphors activated with Rare-Earth Elements.—Z. A. Trapeznikova & V. V. Shchaenko. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1956, Vol. 106, No. 2, pp. 230–232. In Russian.)

535.376 **2081**

The Enhancement Effect of Electric Fields on some X-Ray-Excited Phosphors.—G. Destriau, J. Mattler, M. Destriau & H. E. Gumlich. (*J. electrochem. Soc.*, Dec. 1955, Vol. 102, No. 12, pp. 682–684.) Experimental study of the influence of the strength and frequency of the applied field, the X-ray beam intensity and the temperature on the 'permanent' enhancement effect. See also 2959 of 1954 (Destriau).

535.376 : 546.472.21 **2082**

Frequency Dependence of Electroluminescent Brightness.—W. Lehmann: C. H. Haake. (*Phys. Rev.*, 1st Jan. 1956, Vol. 101, No. 1, pp. 489–491.)

ZnS phosphors activated with Cu and containing small quantities of Fe, Co or Ni are discussed; two different theories are advanced regarding the frequency variation of the electroluminescence.

537.226/.228.1 : 546.431.824-31 **2083**

Electromechanical Properties of Barium Titanate Ceramics.—G. Mesnard & L. Eyraud. (*J. Phys. Radium*, Dec. 1955, Vol. 16, No. 12, pp. 926–938.) The elastic, electrostrictive and dielectric properties of $BaTiO_3$ ceramics have been investigated by a resonance method, using disk specimens with their faces silvered to form capacitors; the equivalent circuit is derived, also the Q factor and the coefficient of electromechanical coupling for static fields up to 20 V/cm and for the temperature range from − 150° to + 150°C.

537.226/.227 : 546.41/.431].824-31 **2084**

Structural Behaviour in the System (Ba, Ca, Sr) TiO_3 and its Relation to Certain Dielectric Characteristics.—M. McQuarrie. (*J. Amer. ceram. Soc.*, Dec. 1955, Vol. 38, No. 12, pp. 444–449.) For compositions near the solubility limits in the ternary system (Ba, Ca, Sr) TiO_3 firing temperature has a marked effect on dielectric properties. No evidence of ferroelectric properties was discovered in $CaTiO_3$–$SrTiO_3$ systems.

537.226/.227 : 546.431.824-31 **2085**

Twinning in Barium Titanate Crystals.—E. A. D. White. (*Acta cryst.*, 10th Dec. 1955, Vol. 8, Part 12, p. 845.)

537.226/.227 : 546.431.824-31 **2086**

Dependence of the Coercive Force and Permittivity of Ceramic Barium Titanate on Mechanical Strains.—N. A. Roi. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 352–355.) Experimental results indicate that the coercivity can be increased by means of mechanical tension. The form of the permittivity/temperature curves cannot be explained on the basis of a simple thermodynamic theory neglecting the effects of changes in the domain structure.

537.226/.227 : [546.48 + 546.33].882.5 **2087**

Solid-Solution Effects, Structural Transitions and Ferroelectricity in Sodium-Cadmium Niobates.—B. Lewis & E. A. D. White. (*Acta cryst.*, 10th Dec. 1955, Vol. 8, Part 12, p. 849.) Results of a detailed experimental investigation of $NaNbO_3$-$Cd_2Nb_2O_7$ ceramics indicate that at any temperature the local Cd concentration within each crystallite determines whether the structure is ferroelectric or antiferroelectric. Microscopically, the ratio of the two modifications depends on the overall Cd concentration and on the temperature.

537.227/.228 **2088**

Electrostriction.—H. F. Kay. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 230–250.) A survey paper. Ferroelectric materials are discussed with particular emphasis on the ceramic-oxide group, in which striction coefficients can be obtained which are high compared with those of true piezoelectric materials having irreversible polarity. There is still considerable doubt as to the exact mechanisms involved. About 50 references.

537.228.1 : 547.476.3 **2089**

Low-Temperature Infrared Absorption Spectrum of Crystallized Rochelle Salt (4 400–7 100 cm^{-1}).—M. P. Bernard. (*C. R. Acad. Sci., Paris*, 20th Feb. 1956, Vol. 242, No. 8, pp. 1012–1013.)

537.311.1/.31 **2090**

Relaxation Fluctuations in Condensed Systems.—P. S. Zyryanov. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3(9), pp. 334–338.) The classification of fluctuations into small-scale (relaxation-type) and large-scale (vibration-type) is considered. The role of relaxation fluctuations in the electrical conductivity of metals is discussed.

537.311.33 **2091**

New Semiconducting Compounds.—E. Mooser & W. B. Pearson. (*Phys. Rev.*, 1st Jan. 1956, Vol. 101, No. 1, pp. 492–493.) Experiments have shown that a large number of compounds of the metalloids Se and Te, which are designated particularly, exhibit typical semiconductor properties.

537.311.33 **2092**

Conductivity and Hall Effect in Semiconductors.—G. Della Pergola. (*Ricerca sci.*, Dec. 1955, Vol. 25, No. 12, pp. 3269–3314.) Theoretical and experimental methods of investigating semiconductors are reviewed. Ionization energies of Ge and Si with various impurities are tabulated. 56 references.

537.311.33 **2093**

Electronic Properties of Aromatic Hydrocarbons.—D. C. Northrop & O. Simpson. (*Proc. roy. Soc. A*, 24th Jan. 1956, Vol. 234, No. 1196, pp. 124–149.) Report of an experimental investigation of electrical conductivity and fluorescence transfer in solid solutions of these substances.

537.311.33 **2094**

Theory of High-Conductivity Semiconductors.—L. L. Korenblit & T. Ya. Shraifel'd. (*Zh. tekh. Fiz.*, June & July 1955, Vol. 25, Nos. 6 & 7, pp. 1019–1025 & 1182–1189.) The electrical properties of some semiconductors over certain ranges of temperature and impurity concentration are quasi-metallic. A detailed mathematical analysis is presented for equilibrium conditions of the current carriers. Formulae are derived for the temperature dependence of conductivity, thermo-e.m.f. and Hall effect for both degenerate and non-degenerate semiconductors.

537.311.33 **2095**

Formation of Mixed Crystals of A^{III} B^{V} Compounds.—O. G. Folberth. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 502–503.) Investigations on InAs-InP and GaAs-GaP compounds are briefly reported. Crystals with any composition in these systems can be formed, the width of the energy gap ranging from 0·33 to 1·25 eV and from 1·45 to 2·25 eV respectively.

537.311.33 **2096**

Isomorphism of Compounds of Type $A^{III}B^{V}$.—N. A. Goryunova & N. N. Fedorova. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1339–1341.) A property important for many technical applications, viz., high mobility of current carriers, has been observed in inorganic semiconductors with a covalent type of bond. In order to be able to vary the properties of such substances, use can be made of the phenomenon of isomorphism, i.e. the ability of the substances to form substitution solid solutions. A report is presented on a radiographic investigation into this property for a wide range of concentrations of the arsenides and antimonides of Ga and In.

537.311.33 **2097**

Bipolar Diffusion of Charge Carriers in Semiconductors in the case of Spherical Symmetry in the Presence of an External Field (Linear Approximation).—M. F. Deigen. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1175–1181.)

537.311.33 **2098**

The Dependence of the Lifetime of Excess Current Carriers on the Concentration of Equilibrium Charge Carriers.—R. Paramonova & A. Rzhanov. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1342–1344.) In connection with an experimental verification of a formula for the lifetime of holes [420 of 1953 (Shockley & Read)], specimens were prepared from a single crystal of Ge. It is not possible to check directly whether the concentration of recombination centres remains constant along the crystal when the concentration of impurities is varied. Indirect arguments support this view, as does also the experimentally obtained linear variation of the lifetime with the inverse value of the concentration of equilibrium charge carriers.

537.311.33: 535.33/.34 **2099**

Study of Absorption and Reflection Spectra in the Visible and Near-Ultraviolet Regions, for some Semiconductors in the form of Thin Plates, at the Temperature of Liquid Nitrogen.—S. Nikitine & R. Reiss. (*C. R. Acad. Sci., Paris*, 20th Feb. 1956, Vol. 242, No. 8, pp. 1003–1005.) Spectral lines attributable to excitons were observed with Cu and Tl halides.

537.311.33: 538.63 **2100**

Theory of the Magnetic Blocking Layer in Semiconductors.—O. Madelung, L. Tewordt & H. Welker. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 476–488.) Previous work [3590 of 1954 (Weisshaar & Welker)] is extended, with particular attention to the distribution of the electron-hole pairs under the influence of the crossed fields, and to the current/voltage characteristic and its relation to surface recombination and specimen dimensions. Photoeffects, frequency variation, and the growth and decay of the blocking layer in response to the field variations are also discussed.

537.311.33: [546.23 + 546.28 + 546.289 **2101**

The Measurement of the Energy Gap of Semiconductors from their Diffuse Reflection Spectra.—P. D. Fochs. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 70–75.) The values deduced by this method for the energy gaps at room temperature are: amorphous Se 1·86 eV, metallic Se 1·74 eV, Si 1·20 eV and Ge 0·69 eV.

537.311.33: 546.23 **2102**

Electron-Optical Investigations of Selenium.—W. Theis. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 503–504, 464b.) Crystal structures observed by electron-diffraction technique in Se films deposited on preheated base plates are illustrated and discussed.

537.311.33: [546.289 + 546.682.86 **2103**

Impurity Scattering in Semiconductors.—R. Mansfield. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 76–82.) Theory is developed and the combination of impurity and lattice scattering is considered for the general case of any degree of degeneracy of charge carriers. Theoretical and experimental results are compared for Ge and InSb.

537.311.33: 546.289 **2104**

The Effect of Heat Treatment on the Concentration and Mobility of Charge Carriers in Germanium.—V. V. Ostroborodova & S. G. Kalashnikov. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1163–1167.) A report is presented on experiments in which Ge specimens were heated to a temperature of 500°C or higher, and then quenched in oil at room temperature. Measurements indicate that the mobility of majority and minority carriers decreases with the approach to the transformation temperature; this may be due to an increase in the volume heterogeneities in the crystal. The concentration of thermal acceptors varies linearly with the reciprocal of temperature in passing from the p into the n region.

537.311.33: 546.289 **2105**

The Recombination of Non-equilibrium Charge Carriers at Thermal Acceptors in Germanium.—V. V. Ostroborodova & S. G. Kalashnikov. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1168–1174.) The effect of heat treatment on the rate of the volume recombination of non-equilibrium electrons and holes in Ge was investigated experimentally; the life-time varies in inverse proportion to the concentration of thermal acceptors. The effective recombination cross-section of the thermal acceptors was $2{\cdot}5 \times 10^{-17}$ cm^2. An estimate of the upper limit of the recombination cross-section for donors shows that its order cannot exceed 10^{-18} cm^2.

537.311.33: 546.289 **2106**

Action of Etchants on Germanium Single Crystals.—G. Della Pergola & D. Sette. (*Alta Frequenza*, Dec. 1955, Vol. 24, No. 6, pp. 499–518.) Four different etchants were applied to the (100) and (111) faces of the crystals for various periods; microscope examinations and resistivity measurements were made after each treatment. The action of the etchants is discussed in terms of energy released, and is illustrated by photomicrograms.

537.311.33: 546.289 **2107**

Magnetic Susceptibility of Low-Resistivity *n*-Type Germanium.—F. T. Hedgcock. (*Canad. J. Phys.*, Jan. 1956, Vol. 34, No. 1, pp. 43–49.) Measurements on polycrystalline specimens over a range of temperatures below room temperature are reported. From the experimental results, the contributions of the free and bound charge carriers to the susceptibility are determined; these appear to vary inversely with temperature. The value deduced for the effective mass of the carriers is 0·16 times that of the free electron mass.

537.311.33: 546.289 **2108**

Review of Germanium Surface Phenomena.—R. H. Kingston. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, pp. 101–114.) "In general the surface may be treated as an assemblage of allowed electron states occurring in the normally forbidden energy range. A review of the measurements of the electrical properties suggests that there are two distinct types of state. The 'fast' state has a hole or electron capture time not greater than a microsecond and is chiefly involved in the recombination process. The 'slow' state has capture times from a millisecond to several minutes and determines the density and type of carrier at the surface. 'Fast' states are believed to occur at the interface between the germanium and the oxide layer, and their density of about 10^{11} cm^{-2} is determined by the initial surface treatment. 'Slow' states are associated with the structure of the oxide layer and the gaseous ambient, and have a density greater than 10^{13} cm^{-2}. Since these states determine the conductivity type at the surface, they contribute to surface 'leakage' in diodes and transistors and, because of their long equilibrium times, to low-frequency noise. The absorption of gases such as water vapor, not only controls the density and energy of the 'slow' states but also leads to possible electrolytic conduction along the surface, in addition to the normal electron flow in the bulk semiconductor."

537.311.33: 546.289 **2109**

Use of Infrared Absorption to determine Carrier Distribution in Germanium and Surface Recombination Velocity.—N. J. Harrick. (*Phys. Rev.*,

1st Jan. 1956, Vol. 101, No. 1, pp. 491–492.) Experiments are briefly described which indicate that surface recombination velocity can be directly evaluated from measurements of infrared absorption. In a particular case, values of 250 cm/s and 1 900 cm/s were obtained for surfaces which had been etched and ground respectively.

537.311.33: 546.289 **2110**

Infrared Absorption in *n*-Type Germanium.—H. Y. Fan, W. Spitzer & R. J. Collins. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 566–572.) Measurements were made at wavelengths from 5 to 38 μ, at temperatures from 78° to 450°K. At the higher temperatures the absorption is proportional to carrier concentration, lattice scattering being the dominant effect. At 78° the absorption per unit carrier concentration comprises a constant term together with a term proportional to the impurity concentration. The absorption increases with wavelength more rapidly at the lower temperatures. The results are in quantitative agreement with theory if the effective carrier mass is assumed to be about 0·1 m.

537.311.33: 546.289 **2111**

Deformation Potential Theory for *n*-Type Ge.—W. P. Dumke. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 531–536.) A calculation is made of the mobility of electrons in Ge using the deformation potential theory of Bardeen & Shockley (3032 of 1950) and taking into account the effect of shear-wave scattering. Values obtained range between 4 550 and 6 700 cm/s per V/cm at 300°K, with a temperature-variation index of $-3/2$. Discrepancies between these results and experimental values are discussed.

537.311.33: 546.289 **2112**

Hall Effect in Oriented Single Crystals of *n*-Type Germanium.—W. M. Bullis & W. E. Krag. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 580–584.) Experimental evidence confirms the variations of Hall coefficient with direction and magnitude of the magnetic field and with direction of current which are predicted by the eight-ellipsoid energy-surface model. The observations can be explained by assuming an energy-independent scattering time. This type of measurement could be used to determine symmetry properties of energy surfaces near a band edge.

537.311.33: 546.289: 535.215: 538.6 **2113**

Saturation of the Photomagnetoelectric Effect in Germanium as a Function of the Magnetic Field.—A. A. Pires de Carvalho. (*C. R. Acad. Sci., Paris*, 6th Feb. 1956, Vol. 242, No. 6, pp. 745–747.) Measurements on small plates of Ge subjected to illumination and to magnetic induction flux densities B up to about 2·7 Wb/m² indicate that the short-circuit current becomes saturated at values of B consistent with the formula $V = CB/[1 + (\mu B)^2]$, where μ is the charge-carrier mobility, C is a constant depending on the wavelength and intensity of the illumination, and V is the photomagnetoelectric voltage.

537.311.33: 546.289: 538.63 **2114**

Magnetic Blocking Layers in Germanium: Part 2.—E. Weisshaar. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 488–495.) Experimentally determined I/V characteristics of symmetrical and asymmetrical blocking layers developed in magnetic fields [3590 of 1954 (Weisshaar & Welker)] and their deviations from the theoretically predicted curves are discussed. The absence of a saturation effect is attributed to the impurity concentration of the Ge specimen used. Measurements of the growth and decay of the layers and of the frequency variation of the current at constant voltage are in good agreement with values calculated from theory for small values of the applied field.

537.311.33: 546.46-31: 535.215 **2115**

Photo-induced Hall Effect in MgO.—E. Yamaka & K. Sawamoto. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 565–566.) Short report of an investigation of the sign of the charge carriers produced by light in the various absorption bands. A hole mobility of about 2 cm/s per V/cm was found.

537.311.33: [546.472.21 + 546.682.86]: 537.228.1 **2116**

Mobility in Zinc Blende and Indium Antimonide.—W. A. Harrison. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, p. 903.) The relations between the piezoelectric properties and the charge-carrier mobility of these materials are discussed.

537.311.33: 546.561-31 **2117**

Surface Conductivity of Copper Oxide.—V. E. Lashkarev & V. I. Lyashenko. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1956, Vol. 106, No. 2, pp. 243–245. In Russian.) Results of experimental determinations of conductivity and carrier mobility in specimens placed in vacuum and in ethylene alcohol vapour at various pressures are discussed.

537.311.33: 546.682.86 **2118**

Optical Properties of Indium Antimonide in the Region from 20 to 200 Microns.—H. Yoshinaga & R. A. Oetjen. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 526–531.) Reflectivity and transmission curves were obtained for large n-type single crystals. The curves indicate a strong lattice vibration at 54·6 μ; absorption and transmission in this spectral region are not greatly affected by the presence of free electrons.

537.311.33: 546.682.86 **2119**

Infrared Absorption of Indium Antimonide.—E. Blount, J. Callaway, M. Cohen, W. Dumke & J. Phillips. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 563–564.) Observations are interpreted in terms of transition between valence and conduction bands.

537.311.33: 546.682.86: 538.6 **2120**

Thermomagnetoelectric Effects in Indium Antimonide.—P. Aigrain, C. Rigaux & J. M. Thuillier. (*C. R. Acad. Sci., Paris*, 27th Feb. 1956, Vol. 242, No. 9, pp. 1145–1148.) Observations of Seebeck and Nernst effects were in good agreement with theoretical predictions; these techniques are useful for determining the ratio of the effective masses and the mobilities of the carriers.

537.311.33: [546.817.231 + 546.817.241 + 546.817.221 **2121**

Photon-Radiative Recombination in PbSe, PbTe and PbS.—I. M. Mackintosh. (*Proc. phys. Soc.*, 1st Jan. 1956, Vol. 69, No. 433B, pp. 115–118.) Analysis indicates that in the absence of traps the maximum attainable lifetimes corresponding to direct electron-hole recombination in PbSe, PbTe and PbS are 0·6, 0·8 and 40 μs, to within factors of 2, 3 and 5 respectively.

537.311.33: 621.314.63 **2122**

The Static Reverse-Voltage/Current Characteristic of the Barrier Layer formed at the Boundary between an *n*-type Semiconductor and a *p*-Type Semiconductor.—E. I. Rashba & K. B. Tolpygo. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1335–1338.) In existing theories of rectification at p-n junctions, recombination and generation of carriers in the space-charge region are not taken into account, and therefore the universal formula (1) for the current

through the semiconductor is not sufficient for determining the properties of *p-n* junctions from the observed *V/I* characteristic. These effects are now considered and an examination is made of the extent to which Shockley's theories (379 of 1950) regarding the variation of quasi-Fermi levels are justifiable.

537.311.33: 621.396.822 **2123**

High-Frequency Shot Noise in *P-N* Junctions.—A. Uhlir, Jr. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 557–558.) A quantitative relation is derived between the frequency variation of the junction conductance and the frequency variation of the shot-noise current. The result obtained is valid for nonplanar as well as planar junctions, and in cases where drift is important.

537.311.4 **2124**

New Low-Contact-Resistance Electrode.—S. S. Flaschen & L. G. Van Uitert. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, p. 190.) The contact resistance of various electrodes was investigated by measuring the resistance of Ni-ferrite specimens to which the contacts were applied. A contact made by rubbing an indium pencil moistened with mercury on to the surface gave both a minimum and a constant resistance over the voltage range 0·01–140 V. Liquid gallium may be substituted for the mercury in some cases.

537.311.4: 537.226 **2125**

Mechanism of Forming of Anode [-interface] **Layers in Formed Dielectrics.**—Ya. N. Pershits. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3(9), pp. 362–368.) Continuation of earlier experiments (448 of February) is reported. The current/time characteristics of the electrode/dielectric contacts were found to be similar for glass, rock salt, skin, and other dielectrics; the curves cannot be explained by assuming motion of cations only; motion of anions must be assumed. No evidence was found of electron conduction.

537.323: 546.3-1-86-24 **2126**

The Thermoelectric Properties of Alloys of the Antimony-Tellurium System.—F. I. Vasenin. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1190–1197.) An experimental investigation was carried out, the main results of which are as follows: (*a*) in the region of the binary system Te-Sb_2S_3 a slow decline of the thermo-e.m.f. curve is observed; this decline becomes a sharp fall when the stoichiometric composition is approached; (*b*) using powder-metallurgy technique it is possible to obtain homogeneous Sb-Te alloys with increased thermo-e.m.f. and electrical conductivity; (*c*) heating of the alloys to 400°C increases the thermo-e.m.f., while the corresponding decrease in electrical conductivity is relatively small; (*d*) addition of Pb decreases the thermo-e.m.f. of Sb and Sb-Te alloys and increases their conductivity.

538.22: 546.711 **2127**

Antiferromagnetic Structure of α-Manganese and a Magnetic Structure Study of β-Manganese.—J. S. Kasper & B. W. Roberts. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 537–544.)

538.22: 621.318.134 **2128**

Comparative Study of the Crystalline Structures of Lanthanum, Praseodymium and Samarium Ferrites.—G. Guiot-Guillain. (*C. R. Acad. Sci., Paris*, 6th Feb. 1956, Vol. 242, No. 6, pp. 793–795.)

538.221 **2129**

Law of Approach to Saturation for a Single Crystal of Fe-Si along the Three Principal Crystallographic Directions.—H. Danan. (*C. R. Acad. Sci., Paris*, 6th Feb. 1956, Vol. 242, No. 6, pp. 748–750.) Measurements are reported which indicate that magnetic hardness is greatest for magnetization along the direction of greatest anisotropy energy.

538.221 **2130**

Demagnetization of Magnetite and of Sesquioxide of α Iron by the Action of Alternating Magnetic Fields.—F. Rimbert. (*C. R. Acad. Sci., Paris*, 13th Feb. 1956, Vol. 242, No. 7, pp. 890–893.)

538.221 **2131**

Influence of Method of Demagnetization of Specimen on Temperature Dependence of Magnetization of Nickel in Weak Fields.—A. I. Drokin & V. L. Il'yushenko. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3(9), pp. 339–344.) The effect of demagnetization by (*a*) heating to a temperature above the Curie point and (*b*) applying an alternating magnetic field, on the subsequent magnetization in a field of strength 0·39 oersted at temperatures between − 183°C and + 360°C is investigated experimentally. The magnetization curves obtained are not identical, probably because in (*a*) the alignment of the domains is random, in (*b*) the domains are antiparallel. The number and magnitude of jumps in the curves are also different.

538.221: 538.569.4.029.6 **2132**

Resonance in α Fe_2O_3.—Y. Kojima. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Dec. 1955, Vol. 7, No. 6, pp. 591–594.) Microwave magnetic resonance in natural single crystals of αFe_2O_3 was observed at several frequencies ranging from 16·5 kMc/s to 48·3 kMc/s. The anisotropic energy was studied as a function of crystal orientation. The *g* factor was also obtained from the resonance data.

538.221: 538.63 **2133**

The Problem of Galvanomagnetic Effects in Ferromagnetic Materials.—K. M. Koch. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 496–498.) The tensor nature of the resistance of a ferromagnetic conductor in a magnetic field is discussed. Experiments are reported on strips of Fe, Ni and alloys arranged rotatably in the field of an electromagnet; pseudo Hall effects were observed confirming the theory presented.

538.221: 621.317.411.029.6 **2134**

Measurement of the Magnetic Permeability of Metals by means of Cavity Resonators, and the Permeability of Iron in the Region of Ferromagnetic Resonance.—K. H. Reich. (*Frequenz*, Sept. & Dec. 1955, Vol. 9, Nos. 9 & 12, pp. 299–305 & 414–422 & Jan. 1956, Vol. 10, No. 1, pp. 11–19.) Various theoretical explanations of the fall of initial permeability with increasing frequency are examined; experiments with ferrites have made it clear that ferromagnetic resonance is an important factor. A method of measurement at cm wavelengths is described in which part of the boundary wall of a cavity resonator is replaced by the ferromagnetic test specimen and the resulting variation of the damping is observed. The effects of pseudo-damping due to the associated circuit arrangements are corrected for. Measurements are reported on iron specimens of various degrees of purity, at room temperature and at 200°C, using direct field strengths up to 11 000 A/cm and a radio frequency of 24·5 kMc/s; the reversible permeability is independent of purity, temperature and crystal orientation relative to the magnetic field. Variation of the permeability with surface roughness and low permeability of unordered specimens are attributed to scatter of the resonance frequencies. For related work, see 829 of March (Standley & Reich). 126 references.

538.221 : 621.318.122 **2135**

Improved Permanent Magnet Materials.—(*Electronic Engng*, April 1956, Vol. 28, No. 338, p. 171.) New types of alcomax with desired anisotropic properties are obtained by making suitable modifications in the composition and applying heat treatment in a magnetic field.

538.221 : 621.318.134 **2136**

Initial Permeabilities of Sintered Ferrites.—G. W. Rathenau & J. F. Fast. (*Physica*, Dec. 1955, Vol. 21, No. 12, pp. 964–970.) Measurements on Ni-Zn ferrites at low frequencies are reported. The results support the conclusion previously reached by Wijn & Went (1633 of 1952) that after demagnetization in an alternating field of decreasing amplitude the magnetization of these materials is almost exclusively caused by simultaneous rotation of the spins.

538.221 : 621.318.134 **2137**

Complex Susceptibility of Magnesium Ferrites.—B. Chiron & P. M. Prache. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 73–74.) Experimental results are presented in a curve using frequency as parameter and choosing the coordinates so as to bring out significant properties of the material. Loops in this curve are attributed to causes other than gyromagnetic resonance.

538.221 : 621.318.134 : 538.6 **2138**

Frequency Doubling in Ferrites.—W. P. Ayres, P. H. Vartanian & J. L. Melchor. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, pp. 188–189.) "A high intensity microwave magnetic field and an orthogonal d.c. magnetic field were applied to a ferrite body. Double frequency magnetic fields were generated in the same direction as the d.c. magnetizing field. A primary frequency of 3 175 Mc/s was used with peak powers up to 200 watts. The peak output power at 6 350 Mc/s was found to increase linearly with the square of the peak input power over a range of 42 dB. Reasonable agreement was found between theory and experiment."

538.222 : 538.569.4 **2139**

Paramagnetic Resonance II.—K. D. Bowers & J. Owen. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 304–373.) A report complementary to that of Bleaney & Stevens (452 of 1954). Paramagnetic-resonance data on salts containing transition-group ions are collected and are discussed in the light of theory presented in simple form. Various physical properties of crystals comprising such ions are elucidated. Over 100 references.

538.569.4 : 546.87 **2140**

Cyclotron Resonance in Bismuth.—M. Tinkham. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, p. 902.) Results obtained by previous workers are discussed in relation to the energy-band structure for Bi first proposed by Jones (*Proc. roy. Soc. A*, 15th Nov. 1934, Vol. 147, No. 861, pp. 396–417).

538.63 : 546.87 **2141**

Galvanomagnetic Effects in Bismuth.—B. Abeles & S. Meiboom. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 544–550.) "Conductivity, Hall effect, and magnetoresistance in single crystals of pure and tin-doped bismuth have been measured as functions of temperature between 80 and 300°K and as functions of magnetic field up to 2 000 oersted. A simple many-valley model for the band structure of bismuth is proposed, and explicit expressions for the galvanomagnetic effects are derived. Numerical values are obtained for the number of conduction electrons and holes, their mobilities, and the overlap of valence and conduction bands."

538.65 **2142**

Magnetostriction and Magnetomechanical Effects.—E. W. Lee. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 184–229.) A review with about 100 references.

538.652 : 546.74 **2143**

Theory of Magnetostriction of Single Crystals of Ni.—N. S. Akulov. (*C. R. Acad. Sci. U.R.S.S.*, 1st Jan. 1956, Vol. 106, No. 1, pp. 31–34. In Russian.)

546.841.05 **2144**

Preparation of High-Purity Thorium by the Iodide Process.—N. D. Veigel, E. M. Sherwood & I. E. Campbell. (*J. electrochem. Soc.*, Dec. 1955, Vol. 102, No. 12, pp. 687–689.)

548.5 : 546.482.21 **2145**

New Method of Preparation of Single Crystals of Cadium Sulphide.—E. Grillot. (*C. R. Acad. Sci., Paris*, 6th Feb. 1956, Vol. 242, No. 6, pp. 779–781.) By sublimation in a tubular furnace heated to above 1 000°, tablets of CdS have been obtained in a few hours having thicknesses of several mm and surface areas of several cm^2, constituted by a mosaic of crystals joined at their lateral faces.

669 **2146**

The Effect of Growth Conditions upon the Solidification of a Binary Alloy.—W. A. Tiller & J. W. Rutter. (*Canad. J. Phys.*, Jan. 1956, Vol. 34, No. 1, pp. 96–121.) A theoretical and experimental analysis is reported of the influence of (*a*) the concentration of solute in the melt, (*b*) the rate of solidification and (*c*) the temperature gradient in the melt at the solid/liquid interface.

669.046.5 : 546.289 + 546.74 **2147**

Floating Zone Melting of Solids by Electron Bombardment.—M. Davis, A. Calverley & R. F. Lever. (*J. appl. Phys.*, Feb. 1956, Vol. 27, No. 2, pp. 195–196.) A rod of the solid material, held upright in chucks in a continuously evacuated enclosure, and maintained at a positive potential of a few kV, is encircled at the level chosen for melting by a heated tungsten filament cathode; a focusing shield is provided to control the length of the zone bombarded. The method is useful for dealing with Si and Ni as well as more refractory materials.

MATHEMATICS

512.37 **2148**

On the Calculation of the Roots of Equations.—E. Frank. (*J. Math. Phys.*, Oct. 1955, Vol. 34, No. 3, pp. 187–197.) The method described, which is an extension of Newton's method of successive approximations, is particularly useful for accurate computations with an ordinary calculating machine.

517 **2149**

Transformations of the Fourier and Laplace Types by means of Solutions of Second-Order Differential Equations.—B. Levin. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1956, Vol. 106, No. 2, pp. 187–190. In Russian.)

517 **2150**

Determination of the Family of Orthogonal Polynomials whose Derivatives are Orthogonal.—R. Campbell. (*C. R. Acad. Sci., Paris*, 27th Feb. 1956, Vol. 242, No. 9, pp. 1110–1111.)

517: 534.01 **2151**

The Initial-Value Problem for the Wave Equation in the Distributions of Schwartz.—J. O'Keeffe. (*Quart. J. Mech. appl. Math.*, Dec. 1955, Vol. 8, Part 4, pp. 422–434.) "The classic formulae for the solution of initial value problems for the wave equation are found in the case of distributions by a Fourier transform method."

517.942.922 **2152**

Tables of $\int_0^x J_0(t)dt$ for Large [values of] x.—P. W. Schmidt. (*J. Math. Phys.*, Oct. 1955, Vol. 34, No. 3, pp. 169–192.) The Bessel function is tabulated in steps of 0·2 for the range $10<x<40$.

517.942.932 **2153**

On Periodic Solutions of Duffing's Equation with Damping.—W. S. Loud. (*J. Math. Phys.*, Oct. 1955, Vol. 34, No. 3, pp. 173–178.) Special cases are considered of the equation $\ddot{x} + f(x)\,\dot{x} + g(x) = p(t)$, where $f(x)$ is an even function, $g(x)$ is an odd function, and $p(t)$ is periodic and odd-harmonic.

518.2 **2154**

Formulas for Inverse Osculatory Interpolation.—H. E. Salzer. (*J. Res. nat. Bur. Stand.*, Jan. 1956, Vol. 56, No. 1, pp. 51–54.) The formulae presented provide an improved means for inverse interpolation in tables where the first derivative is either tabulated alongside the function, as in Bessel functions of the first and second kind, or where it is easily obtained, as in the elementary trigonometrical functions and their integrals.

MEASUREMENTS AND TEST GEAR

531.789.1: 538.22 **2155**

Torsion Balance for a Single Microscopic Magnetic Particle.—S. P. Yu & A. H. Morrish. (*Rev. sci. Instrum.*, Jan. 1956, Vol. 27, No. 1, pp. 9–11.) The balance described may be used for measurements on individual magnetic particles of diameters down to about 1μ (mass $\sim 10^{-13}$ g).

538.569.4.029.6:535.33 **2156**

Millimeter and Submillimeter Wave Spectroscopy.—C. A. Burrus & W. Gordy. (*Phys. Rev.*, 15th Jan. 1956, Vol. 101, No. 2, pp. 599–602.) Apparatus and results are described. The energy source is a Si-crystal frequency multiplier driven by a cm-λ klystron. An evacuated bolometer is used as detector at wavelengths down to 2 mm. A Si-crystal detector is also used.

621.317.3: 621.315.212: 621.3.013.78 **2157**

Measurement of Coupling Impedance and its Application to the Study of Cable Screens.—Bourseau & Sandjivy. (See 1950.)

621.317.33: 621.372.413: 537.311.33 **2158**

A Microwave Resonant Cavity Method for measuring the Resistivity of Semiconducting Materials.—J. G. Linhart, I. M. Templeton & R. Dunsmuir. (*Brit. J. appl. Phys.*, Jan. 1956, Vol. 7, No. 1, pp. 36–38.) "A small spherical or cubic specimen is placed in a cavity resonating in the H_{011} mode, and the reduction in Q due to eddy-current loss in the specimen is measured. The theory given enables the resistivity of the material to be calculated. It is shown that resistivities in the range 0·005 to 10 Ω cm can be determined."

621.317.335.3 **2159**

Dielectric Constant of Water from 0° to 100°C.—C. G. Malmberg & A. A. Maryott. (*J. Res. nat. Bur. Stand.*, Jan. 1956, Vol. 56, No. 1, pp. 1–8.) Measurements made using a low-frequency bridge with a Wagner earth are reported. The accuracy was within 0·1%. The value found at 25°C was 78·30, about 0·3% less than that usually accepted. A formula is derived for the temperature variation of the dielectric constant. Sources of error in the experimental method are considered in detail.

621.317.335.3.029.6 **2160**

A Method for determining Complex Dielectric Constants of Very Small Amounts of Material (0.1 cm³) at Decimetre Wavelengths.—H. Lueg & H. K. Ruppersberg. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 533–540). A coaxial-line method is described in which the line stands vertical and the inner conductor is adjustable axially. When the inner conductor is pulled down a few tenths of a millimetre, a cavity is formed into which the test material can be inserted. In this position the field strength is a maximum, so that the specimen/air interface is nearly free from induction and field currents. With liquid specimens, two drops suffice; with solid specimens, thin disks are used.

621.317.411.029.6: 538.221 **2161**

Measurement of the Magnetic Permeability of Metals by means of Cavity Resonators, and the Permeability of Iron in the Region of Ferromagnetic Resonance.—Reich. (See 2134.)

621.317.42 **2162**

Methods of measuring Strong Magnetic Fields.—J. L. Symonds. (*Rep. Progr. Phys.*, 1955, Vol. 18, pp. 83–126.) A survey covering methods based on magnetic resonance, magnetoresistance, the Hall effect, peaking strips, the generator principle, the fluxmeter, and forces on current-carrying conductors. The technique of determining the magnetic median plane is discussed, and several less used methods of measurement are mentioned. About 150 references.

621.317.42: 621.383 **2163**

The Photoelectric Fluxmeter.—S. P. Kapitsa. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1307–1315.) A detailed description and analysis of operation of the 'photoelectric hysteresisgraph' [*Elect. Engng, N.Y.*, July 1937, Vol. 56, No. 7, pp. 805–809 (Edgar)]. The frequency characteristics are considered. Conditions for distortion correction are established and the advantages of using negative feedback are indicated. The theoretical results are illustrated by oscillograms of transient processes.

621.317.44 **2164**

Improved Method for observing Hysteresis Cycles with the Iliovici Permeameter.—R. Dehors & L. Garde. (*C. R. Acad. Sci., Paris*, 6th Feb. 1956, Vol. 242, No. 6, pp. 751–753.)

621.317.7: 621.372.8 **2165**

Bibliography on Directional Couplers.—R. F. Schwartz. (*Trans. Inst. Radio Engrs*, April 1955, Vol. MTT-3, No. 3, pp. 42–43.) Addendum to 208 of 1955.

621.317.7: 621.396.81 **2166**

New Apparatus for determining the Statistical Distribution of Random Electrical Processes.—J. Grosskopf, K. H. Kappelhoff & G. Kopte. (*Nachrichtentech. Z.*, Jan. 1956, Vol. 9, No. 1, pp. 34–39.)

Automatic recording apparatus for studying radio signal-strength variations is described. The time-distribution curve is displayed every half-hour; accuracy of measurements is adequate for fading frequencies up to 10 kc/s. The evaluation of the 18-hour daily records is performed by one operator in about half-an-hour, using templates.

621.317.7 : 621.396.822.1 : 621.396.41 **2167**

Equipment for Measurement of Interchannel Crosstalk and Noise on Broad-Band Multichannel Telephone Systems.—R. W. White & J. S. Whyte. (*P.O. elect. Engrs' J.*, Oct. 1955, Vol. 48, Part 3, pp. 127–132.) A band of noise covering the frequency range of a multichannel system is passed through a narrow-band-stop filter, giving the equivalent of a fully loaded system with one quiet channel. Intermodulation measurements may be made in the quiet channel. The method may be used to investigate coaxial-cable systems as well as microwave radio links.

621.317.71 : 620.193 **2168**

An Electronic Self-Balancing Zero-Resistance Ammeter.—D. R. Makar & H. T. Francis. (*J. electrochem. Soc.*, Dec. 1955, Vol. 102, No. 12, pp. 669–670.) Description of an instrument for continuous observation of the short-circuit current flowing in a galvanic corrosion cell. It comprises a 60-c/s chopper circuit, amplifier, phase-detector, relay and balancing circuit. The sensitivity is 50 μV with current range 20 mA.

621.317.729.029.6 **2169**

Measurement of Time-Quadrature Components of Microwave Signals.—J. H. Richmond. (*Trans. Inst. Radio Engrs*, April 1955, Vol. MTT-3, No. 3, pp. 13–15.) Equipment for measuring the real and imaginary components of a signal is described; it uses two barretters as detectors and is less elaborate than would be required for separate measurement of amplitude and phase.

621.317.729.029.6 **2170**

Probes for Microwave Near-Field Measurements.—J. H. Richmond & T. E. Tice. (*Trans. Inst. Radio Engrs*, April 1955, Vol. MTT-3, No. 3, pp. 32–34.) Details are given of the construction of waveguide probes which permit the calculation of far-field signal strengths in good agreement with measured values.

621.317.733 **2171**

Compensating Recording Bridge for Measurement of Capacitance and Loss Factor.—H. Poleck. (*Elektrotech. Z., Edn A*, 1st Dec. 1955, Vol. 76, No. 23, pp. 822–826.) A modified Schering bridge is described.

621.317.733 **2172**

A Simple Auxiliary Bridge for Accurate Measurements of Loss Factor with the Schering Bridge.—A. Keller. (*Elektrotech. Z., Edn A*, 1st Dec. 1955, Vol. 76, No. 23, pp. 826–827.)

621.317.755 **2173**

Signal-Triggered Sweep magnifies Pulse Widths.—R. L. Kuehn. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 146–147.) A c.r.o. circuit is described which incorporates an automatic change-over from recurrent-sweep to triggered-sweep operation; the display corresponding to a signal pulse can be expanded as desired by increasing the recurrent-sweep frequency.

621.317.755.029.3 **2174**

Audio-Frequency Spectrometer.—W. Kaule & A. Johne. (*NachrTech.*, Jan. 1956, Vol. 6, No. 1, pp. 35–39.) The operation of a new c.r.o. instrument using only six filters is described. Over the frequency range 0–1 kc/s the analyser bandwidth is 50 c/s; over the range 0–20·5 kc/s it is 500 c/s.

621.317.76 : 621.396.61 **2175**

The Frequency-Band Recorder.—H. Fleischer & H. Widdra. (*Nachrichtentech. Z.*, Jan. 1956, Vol. 9, No. 1, pp. 21–28.) An automatic instrument for measuring and recording the principal features of radio signals in accordance with the international monitoring system is described. The features covered are frequency, field strength, bandwidth, duration, type of modulation, and transmitter frequency deviation. The instrument can be used in conjunction with different receivers to suit the frequency and sensitivity requirements; the construction permits not more than three frequency sweeps of the receiver to be recorded per min. The receiver feeds an amplifier which modulates a variable-delay thyratron driving the recording pen. Typical records are reproduced.

621.317.761 **2176**

Phase-Bridge Frequency Meters.—C. Février. (*Rev. gén. Élect.*, Jan. 1956, Vol. 65, No. 1, pp. 34–38.) In this type of instrument, frequency variations are converted into phase variations which in turn are converted into variations of a direct voltage by means of the phase bridge. The design of circuits to give an indication independent of signal amplitude and harmonic content is discussed, and the merits of some known arrangements for converting from frequency to phase variations are compared.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.2-8 : 539.32 **2177**

Apparatus for the Measurement of Physical Constants by the Elastic-Vibrations Method.—A. V. J. Martin (*J. Brit. Instn Radio Engrs*, March 1956, Vol. 16, No. 3, pp. 167–183.) Ultrasonic techniques for determining elastic constants are surveyed. Equipment is described suitable for testing gaseous, liquid and solid specimens. The frequency range is 0·5–50 Mc/s, the temperature range 0°–100°C, and the pressure range up to 10 000 kg/cm². 40 references.

534.2-8 : 61 **2178**

Ultrasonic Irradiation of the Central Nervous System at High Sound Levels.—W. J. Fry & F. Dunn. (*J. acoust. Soc. Amer.*, Jan. 1956, Vol. 28, No. 1, pp. 129–131.)

534.2-8 : 61 **2179**

High-Intensity Ultrasonic Oscillations for Treatment of Malignant Tumours in Animals and in Man.—A. K. Burov. (*C. R. Acad. Sci. U.R.S.S.*, 11th Jan. 1956, Vol. 106, No. 2, pp. 239–241. In Russian.) Experimental results indicate that some tumours on the surface of the skin may successfully be treated using 1·5-Mc/s ultrasonic beams of intensities up to 350 W/cm² (continuous) or 600 W/cm² (pulsed). Quartz-plate transducers with surface areas up to 50 cm² were used. No constructional details are given. For experimental results, see also *ibid.*, 21st Jan. 1956, Vol. 106, No. 3, pp. 445–448 (Burov & Andreevskaya).

535.42 : 548 : 621.397.6 **2180**

Apparatus for the Electronic Presentation of Optical Diffraction Patterns.—A. W. Hanson & A. Menarry. (*J. sci. Instrum.*, Jan. 1956, Vol. 33, No. 1, pp. 24–27.) "An image of the diffraction pattern is focused on the photomosaic of a television camera tube capable of accumulating, for a period of about ten

seconds, a corresponding charge pattern. This pattern is transferred to a storage device where it remains for a relatively long time during which it can be continuously presented on a television receiver.''

537.534.9: 621.314.632: 546.28 **2181**

Solid-State Detector for Low-Energy Ions.—O. Heinz, E. M. Gyorgy & R. S. Ohl. (*Rev. sci. Instrum.*, Jan. 1956, Vol. 27, No. 1, pp. 43–47.) Experimental results of bombardment of silicon by He^+ ions through a silver film deposited on the surface show that the rectifying properties are modified so as to increase the turnover voltage. Ion energies up to 30 keV and dosages up to 1 800 $\mu C/cm^2$ were used.

621.3: 620.16: 681.142 **2182**

Shock Spectrum Computer for Frequencies up to 2 000 c/s.—Morrow & Riesen. (See 1969.)

621.3: 681.8: 78 **2183**

Electronic Music.—H. Le Caine. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 457–478.) A comprehensive discussion dealing with fundamental aspects and particular instruments and techniques. Various means of achieving interpretative effects are indicated. Coded-performance devices are described, including those used by the Musique Concrète group in Paris and the Cologne studio for electronic music.

621.317.39: 534.6: 621.385.83 **2184**

Electron-Acoustic Image Converter.—P. K. Oshchepkov, L. D. Rozenberg & Yu. B. Semennikov. (*Akust. Zh.*, Oct.–Dec. 1955, Vol. 1, No. 4, pp. 348–351.) The tube described uses a $BaTiO_3$ screen at which an ultrasonic field is converted into an electric-charge distribution which is scanned by an electron beam. The response at frequencies of a few Mc/s is linear over the intensity range $3 \times 10^{-9} - 3 \times 10^{-3}$ W/cm². The sensitivity of the instrument is 2×10^{-8} V/bar.

621.384.612 **2185**

Scattering of Protons by Residual Gas in a Synchrotron: Part 1 — Elastic Scattering.—J. Seiden. (*J. Phys. Radium*, Dec. 1955, Vol. 16, No. 12, pp. 917–925.) The amplitude of oscillations set up by elastic collisions of the accelerated protons with gas molecules is directly proportional to the square root of the gas pressure and inversely proportional to the square roots of the energy of injection and of the energy gain per revolution. Direct losses of protons by single collisions vary in the same way; the calculated values for certain existing synchrotrons range between 2% and 14%.

621.384.612 **2186**

Space Charge and Ionization Phenomena in Constant-Gradient Proton Synchrotrons.—P. B. Moon. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434A, pp. 153–156.) The calculation of space-charge effects for constant-gradient machines is simpler than for the alternating-gradient ones discussed by Barden (2485 of 1954).

621.385.833 **2187**

Electron Optics of Cylindrical Systems having a Plane of Symmetry: Part 2—Aberrations.—M. Laudet. (*J. Phys. Radium*, Dec. 1955, Vol. 16, No. 12, pp. 908–916.) Aberration formulae are derived following the method proposed by Durand (1756 of 1955). Part 1: 2391 of 1955.

621.389: 535.833 **2188**

Role of Saturation in the Limitation of [star] Magnitudes attained by Classical Photography and by Use of the Electron Telescope.—P. Vernier. (*C. R. Acad. Sci., Paris*, 20th Feb. 1956, Vol. 242, No. 8, pp. 1006–1008.)

621.398 **2189**

Telemetering—Electronic Data Transmission.—A. A. McKenzie & H. A. Manoogian. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 153–180.) A survey under the headings: systems development; input transducers; signalling methods; commutating devices; output indicators. An extensive bibliography is included.

655: 621.37/.38] + 621.397 **2190**

Electronic Methods of Pictorial Reproduction.—(*J. Brit. Instn Radio Engrs*, March 1956, Vol. 16, No. 3.) The text is given of the following papers, presented at a symposium held in January 1956:—

Facsimile Transmission of Weather Charts and Other Material by Landline and Radio.—J. A. B. Davidson (pp. 115–124).

Facsimile Communication.—H. F. Woodman & P. H. J. Taylor (pp. 129–144).

Electronic Engraving.—S. W. Levine & A. B. Welch (pp. 145–152).

Tone Reproduction with Electronically Cut Stencils.—R. Lant (pp. 153–157).

Discussion on the above papers is given on pp. 158–161.

PROPAGATION OF WAVES

621.396.11 **2191**

Propagation of Electromagnetic Waves over the Spherical Earth across Boundaries separating Different Earth Media.—K. Furutsu. (*J. Radio Res. Labs, Japan*, Oct. 1955, Vol. 2, No. 10, pp. 345–398.) Formulae for propagation over one or two boundaries agree with those for a homogeneous earth in special cases. A rigorous proof is given of a general formula for propagation over any number of boundaries, and methods of summation are discussed. For the case of a flat earth, see 541 of February and 1848 of June.

621.396.11 **2192**

On the Multiple Scattering of Waves by an Irregular Medium.—H. Hojo. (*J. Radio Res. Labs, Japan*, Oct. 1955, Vol. 2, No. 10, pp. 419–427.) Expressions are derived, assuming irregularities in one direction only, for the power distribution among the incident wave and singly, doubly and triply scattered waves in the forward and backward directions. Near the critical frequency in an ionized medium, intense and diffuse reflections may occur.

621.396.11 **2193**

Forward Scatter of Radio Waves.—(*Tech. News Bull. nat. Bur. Stand.*, Jan. & Feb. 1956, Vol. 40, Nos. 1 & 2, pp. 8–12 & 24–29.) A short survey of N.B.S. investigations of scatter propagation via the ionosphere and via the troposphere. For detailed papers, see *Proc. Inst. Radio Engrs*, Oct. 1955.

621.396.11: 551.510.535 **2194**

D-E Layer Electron Model reduced from Considerations of M.F. and H.F. Wave Absorption.—T. Kobayashi. (*J. Radio Res. Labs, Japan*, Oct. 1955, Vol. 2, No. 10, pp. 399–412.) The model developed is used as a basis for calculating the field strength of waves transmitted over a 1 200-km path by a single E-layer reflection. The results are shown graphically; they differ markedly from corresponding curves derived from National Bureau of Standards charts published in 1948.

621.396.11: 551.510.535 **2195**

The Z Propagation Hole in the Ionosphere.—G. R. Ellis. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 43–54.) The transformation of the ordinary wave to an extraordinary wave under certain conditions gives rise to a 'propagation hole' at the

ordinary reflection level. Two methods of estimating the angular size of the 'hole' are based on: (*a*) measurement of *Z*-echo power; (*b*) analysis of the distribution of angle of arrival of *Z* echoes. Measurements at Hobart at a frequency of 4·65 Mc/s show the 'hole' to be approximately circular, with an angular width to half-power points of $< 0{\cdot}84°$.

621.396.11 : 550.551.535 **2196**

Interaction of Ordinary and Extraordinary Waves in the Ionosphere and the Effect of Multiplication of Reflected Waves.—N. G. Denisov. (*Zh. eksp. teor. Fiz.*, Sept. 1955, Vol. 29, No. 3(9), pp. 380–381.) The propagation of e.m. waves in the ionosphere is considered for the case of a small angle between the direction of propagation and the magnetic field. Strong interaction between the ordinary and extraordinary waves takes place in the region where the refractive indices are nearly equal and, as a result, the ordinary wave becomes an extraordinary wave; this leads to multiple reflections. Application of the mathematical methods originally developed for inelastic collisions between atoms [*Helv. phys. Acta*, 1932, Vol. 5, No. 6, pp. 369–422 (Stueckelberg)] leads to simple expressions for the reflection and transmission coefficients in terms of the ordinary and extraordinary refractive indices.

621.396.11 : 551.510.535 **2197**

The Interpretation of Measurements of Radio-Wave Interaction.—L. G. H. Huxley. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 118–120.) The original formula relating the rate R at which electrons with energy Q lose energy in collisions with molecules is rewritten $R = B_n (Q - Q_0)$, where B is a function of Q and Q_0 that is effectively constant when $(Q/Q_0 - 1) \ll 1$, and n is the molecular concentration. Earlier results interpreted according to this formula give a range of n from $1{\cdot}2 \times 10^{14}$ to 3×10^{14} per cm^3 for height 83–90 km. These heights are consistent with values determined from the phase of cross-modulation.

621.396.11 : 551.510.535 **2198**

On the Observation of Ionospheric Self-Interaction.—F. H. Hibberd. (*J. atmos. terr. Phys.*, Feb. 1956, Vol. 8, Nos. 1/2, pp. 120–122.) "Essential precautions are described that must be taken in experimental studies of ionospheric self-interaction to avoid misleading results caused by interference between various rays and by the bandwidth of the receiver."

621.396.11 : 621.396.65 **2199**

Physical Problems of Transmission over Radio Links.—J. Fagot. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 7–22.) Basic problems discussed include the development of an adequate signal/noise ratio, the effect of different propagation paths, and distortion due to frequency variation of propagation velocity over the transmitted band.

621.396.11 : 621.396.65 **2200**

The Radio Link under Conditions of Atmospheric Superrefraction.—L. Sacco. (*Alta Frequenza*, Dec. 1955, Vol. 24, No. 6, pp. 436–469.) Superrefraction is commonly experienced in Italy at altitudes up to 500 m. An investigation is made of the geometrical features (reflection points, path differences and convergence coefficients) of the radio link under these conditions, and the value of the received field strength is calculated. Focusing and multiple-reflection effects are discussed.

621.396.11 : 621.396.674.3 **2201**

Transient Fields of a Vertical Dipole over a Homogeneous Curved Ground.—Wait. (See 1959.)

621.396.11.029.55 : 523.746 **2202**

Oblique Incidence and Sunspots.—R. Gea Sacasa. (*Rev. Telecomunicación, Madrid*, Dec. 1955, Vol. 9, No. 42, pp. 17–31. In Spanish and English.) Twenty-four charts of m.u.f. predictions by various national laboratories, based on the index of solar activity, are compared with predictions by Gea's method. For periods of high solar activity, in summer, the former predictions are too low and are in better agreement with the observations if displaced by six months. With the accuracy of prediction at present attained there is no experimental confirmation of the need to vary the predictions over the eleven-year cycle.

621.396.11.029.63 **2203**

The Influence of Atmospheric Turbulence on Ultra-short-Wave Radio Links across the Mediterranean.—F. du Castel. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 32–42.) Receiving stations working on wavelengths of 10, 22 and 70 cm were sited at various heights above and below the transmitter horizon. The signal-strength patterns caused by turbulence are described and probable values of the parameters involved are deduced. A mean 'scale of turbulence' of 17 m is indicated, as against measured values in the range 20–130 m obtained in the U.S.A. by Gordon (1136 of 1955).

621.396.81 : 621.317.7 **2204**

New Apparatus for determining the Statistical Distribution of Random Electrical Processes.—Grosskopf, Kappelhoff & Kopte. (See 2166.)

621.396.812.3.029.63 **2205**

Diversity Tests and Study of Focusing Effects on Long Line-of-Sight Radio Links.—Rivet. (See 2210.)

621.396.812.3.029.64 **2206**

An Interpretation of the Statistics of Fading over Optical-Range Microwave Radio Paths.—G. Kraus. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 19–25.) Fading due to tropospheric ducts is investigated. It is assumed that the signal at the receiver comprises a principal ray together with a number of subsidiary rays with random phases. The degree of stratification is characterized by the fraction q contributed by the subsidiary rays; the higher the value of q the greater the fluctuations of signal power about the mean value associated with the main ray. When $q = 1$, the depth of fading is at least 20 dB for 1% of the time. The results are in fairly good agreement with published observations of fading.

621.396.812.3.029.64 **2207**

Interference Fading caused by Frontal Discontinuities.—P. Misme. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 43–47.) Microwave fading is produced due to varying convergence of rays in the horizontal plane by sharply defined fronts characterized by stationary or rising temperature and falling humidity. Field-strength records showing the effect of a normal cold front and the passage of a storm are presented.

RECEPTION

621.376.232.2 : 621.396.62 : 621.396.822 **2208**

Effect of Electrical Fluctuations on a Detector (Wave-Envelope Method).—V. I. Tikhonov. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, Oct. 1955, No. 10, pp. 3–13. In Russian.) The detection of a signal which is modulated in amplitude and phase by voltage fluctuations in the i.f. amplifier is considered theoretically for a diode detector with (*a*) a linear, (*b*) a quadratic, and (*c*) an exponential characteristic. Results

are also given of an experimental investigation of the modification of the detected voltage probability distribution by the time constant of the detector *RC* circuit.

621.396.62 : 621.396.3 : 621.376.3 **2209**

Automatic Frequency Control in Frequency-Shift Radiotelegraphy.—A. Niutta: G. Bronzi. (*Alta Frequenza*, Dec. 1955, Vol. 24, No. 6, pp. 519–522.) Discussion on 253 of January and author's reply.

621.396.812.3.029.63 **2210**

Diversity Tests and Study of Focusing Effects on Long Line-of-Sight Radio Links.—P. Rivet. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 23–32.) Signal-strength records obtained with transmissions on $\lambda = 10$, 20 and 30 cm, over a distance of 230 km, are discussed. Both space and frequency diversity were employed. Fading phenomena affecting large areas and local interference fading effects were observed. The fine structure of the records cannot be satisfactorily explained without further theoretical and experimental investigation of focusing effects due to variations of atmospheric refraction.

621.396.82 : 621.397.62 **2211**

Parasitic Radiations from Television Receivers.—Egidi & Maggiore. (See 2237.)

621.396.823 : 621.316.13 **2212**

Measurement of H.F. Interference by 380-kV Installations in Sweden.—R. Bartenstein, A. Bergman & L. Menstell. (*Elektrotech. Z., Edn A*, 11th Dec. 1955, Vol. 76, No. 24, pp. 857–859.) Field-strength measurements in the frequency range 150 kc/s to about 15 Mc/s and symmetrical line-interference-voltage measurements between 40 and 200 kc/s were made on two h.v. overhead lines of respective lengths 1·7 km and 207 km. The ratios of the interference voltages and of the field strengths are fairly well represented by the two formulae given. Results are presented graphically.

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 **2213**

Tables of Bennett Functions for the Two-Frequency Modulation Product Problem for the Half-Wave Square-Law Rectifier.—R. L. Sternberg, J. S. Shipman & H. Kaufman. (*Quart. J. Mech. appl. Math.*, Dec. 1955, Vol. 8, Part 4, pp. 457–467.) A companion set to the tables presented previously by Sternberg et al. (1779 of 1955).

621.376.55 : 621.397.5 **2214**

Multiple-Pulse-Time Modulation.—H. J. Griese. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 571–572). Signal/noise ratio can be improved in a system in which a multiple pulse is phase modulated, because the width of the transmitted frequency band can be reduced. The phase shifts corresponding to the signal and simultaneous noise are integrated in an oscillating circuit whose output is rectified and smoothed to give a single phase-modulated pulse which is demodulated in the usual way. Individual communication channels can be selected by frequency separation instead of or combined with time separation. The system is suitable for television sound.

621.39(54) **2215**

Research in Electrical Communications in India since 1865.—S. P. Chakravarti. (*J. Instn Telecommun. Engrs, India*, Dec. 1955, Vol. 2, No. 1, pp. 7–18.) A short review with 157 references.

621.39.001.11 **2216**

Prolongation [extrapolation] **of Signals with Limited Spectrum.**—J. A. Ville. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 44–52). Analysis based on operational methods indicates that extrapolation to instants corresponding to $t > 0$ cannot be effected in practice, though theoretically possible.

621.39.001.11 : 519 **2217**

Theory of the Reliability of Operation of Systems comprising a Large Number of Elements.—Sh. L. Bebiashvili. (*Bull. Acad. Sci. U.R.S.S., tech. Sci.*, Oct. 1955, No. 10, pp. 29–39. In Russian.) The reliability of a system such as a radio-relay system is calculated as a function of the probable lifetime of its elements (e.g. valves) and the method of operating the groups and elements of the system.

621.395.44 + 621.396.41 **2218**

Carrier-Frequency Installations for Cables, Overhead Lines and Radio Paths.—H. Hannemann & H. Piechatzek. (*Nachrichtentech. Z.*, Jan. 1956, Vol. 9, No. 1, pp. 10–18.) Survey of methods used by a German company to standardize the equipment for carrier systems with different numbers of channels.

621.396.41 : 621.396.822.1 **2219**

Nonlinear Cross-Talk in Multicarrier Multichannel Systems.—P. Güttinger. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 573–577.) Analysis is presented for a system in which the individual carriers are phase modulated and all lie within one octave. By suitable design and operation of the mixer, interference products can be kept low.

621.396.61 : 621.317.76 **2220**

The Frequency-Band Recorder.—Fleischer & Widdra. (See 2175.)

621.396.66 : 534.861 **2221**

Monitoring Sound Broadcast Programmes.—T. Somerville. (*Wireless World*, May 1956, Vol. 62, No. 5, pp. 228–231.) A brief review is given of the evolution of methods used by the B.B.C. in assessing the quality of the a.f. signal leaving the broadcasting studios. The selection of the loudspeaker and problems of studio and listening-room acoustics are briefly discussed.

621.396.8 **2222**

Theoretical and Experimental Study of Signal Interference in Radiocommunication Systems.—J. Villepelet. (*Ann. Télécommun.*, Dec. 1955, Vol. 10, No. 12, pp. 264–276 & Jan. 1956, Vol. 11, No. 1, pp. 8–24.) The protective effect of receiver selectivity in amplitude-keyed communication systems is analysed in detail. The required relation between the dynamic selectivity curve for the system and the static selectivity curves of the receiver filters is examined. If an interfering pulse signal is filtered through a circuit tuned to its carrier at an early stage in the receiver, the width of the dynamic selectivity curve is reduced appreciably. Experimental confirmation of the results is reported. The properties of the dynamic selectivity curve are determined for a.m., ph.m. and f.m. systems. It is possible to realize a system with a frequency occupancy as low as that of a system in which only static interference is present. To achieve this, the spectral curve of the transmitter must slope off at least as fast as the asymptotic slope of the receiver selectivity curve, which should be as great as possible.

SUBSIDIARY APPARATUS

621.316.7 : 621.387 **2223**

A Magnetic Thyratron Grid Control Circuit.—J. H. Burnett. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 529–532.) A circuit described previously (1983 of 1951) is modified by including an a.c. source and a rectifier in the secondary circuit of the grid transformer, changing the mode of operation to that of a reset magnetic amplifier. A 180° range of firing-voltage phase is available; the firing voltage builds up rapidly.

621.35 **2224**

Chemical Generation and Storage of Electricity.—A. M. Adams. (*J. Instn elect. Engrs*, Jan. 1956, Vol. 2, No. 13, pp. 7–13.) A review of recent work on fuel cells, whose operation is based on oxidation of carbon and hydrogen, and which give a low-voltage d.c. output; the particular importance of this type of cell is that it may give higher efficiency in the use of primary fuels.

621.352.32 **2225**

Some Basic Scientific Problems relating to [Leclanché-type] **Manganese Dioxide Electrochemical Cells.**—J. Brenet. (*Rev. gén. Élect.*, Jan. 1956, Vol. 65, No. 1, pp. 61–64.)

TELEVISION AND PHOTOTELEGRAPHY

621.397 + [621.37/.38 : 655 **2226**

Electronic Methods of Pictorial Reproduction.—(See 2189.)

621.397.24 : 621.372.55 **2227**

Phase-Correcting All-Pass Sections. Design of a Delay Equalizer for Television Transmission.—H. Martin. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 31–43.) Continuation of earlier work (1196 of 1954). Nomograms facilitating design calculations are presented. Calculations are made for equalizing a Paris-Soissons coaxial-pair circuit for television transmission.

621.397.26 : 621.396.65.029.63 **2228**

I.T.A. [Independent Television Authority] **Midlands Relay.** (*Wireless World*, May 1956, Vol. 62, No. 5, pp. 223–226.) The Lichfield television station is connected by two radio links, using frequencies of 1·712 and 1·784 kMc/s, and one return link on 2·216 kMc/s, to the Telephone House in Birmingham, 12 miles distant. The three channels share a single aerial at each terminal, horizontal polarization being used for the one direction of transmission and vertical for the other. Frequency modulation is used; the bandwidth occupied by the signal at peak deviation is about 14 Mc/s. The equipment is briefly described.

621.397.5 : 621.376.55 **2229**

Multiple-Pulse-Time Modulation.—Griese. (See 2214.)

621.397.5(46) **2230**

National Plan for Television [in Spain].—J. Sánchez-Cordovés, I. Miró & E. Gavilán. (*Rev. española Electrónica*, Dec. 1955, Vol. 2, No. 13, pp. 18–20.) The first stage of the plan envisages one transmitter at Madrid and another at Barcelona, with power initially 1·5 kW for image and 500 W for sound rising later to 15 kW for image and 5 kW for sound. Band-I frequencies of 55·25 Mc/s for image and 60·75 Mc/s for sound are to be used, with 625-line standards. Second- and third-stage plans are outlined.

621.397.6.001.4 **2231**

Circuit Technique for Generation of Electrical Test Patterns in Television.—F. Pilz. (*Arch. elekt. Übertragung*, Dec. 1955, Vol. 9, No. 12, pp. 547–558.) Discussion of methods for producing test patterns without using optical or electron-optical arrangements, i.e. using only combinations of pulse signals. A unit developed at the Nuremberg Rundfunk-Technisches Institut is described.

621.397.61 : 535.623 **2232**

Correction Circuits for Color TV Transmitters.—K. E. Mullenger & R. H. McMann, Jr. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 130–133.) Gamma and matrix correction circuits designed primarily for reproduction of colour films but useful also for live colour transmissions are described.

621.397.611.2 : 621.383.27 **2233**

Flying-Spot Scanning and the Transmission of Episcopic Pictures.—H. Stier, P. Lindner & E. Kosche. (*NachrTech.*, Dec. 1955, Vol. 5, No. 12, pp. 537–541.) Description of an electron-optical epidiascope used at the East Berlin Television Centre.

621.397.62 **2234**

Trends in 1955–56 TV Receivers [in the U.S.A.].—R. F. Scott. (*Radio-Electronics*, Jan. 1956, Vol. 27, No. 1, pp. 36–39.)

621.397.62 **2235**

Linear-Phase-Characteristic Television Receivers.—A. van Weel. (*Onde élect.*, Jan. 1956, Vol. 36, No. 346, pp. 48–56.) Phase distortion is practically eliminated by provision of a linear-phase i.f. amplifier, using simple circuitry. Selectivity is normal and disadvantages of phase compensations at video frequency are avoided. See also 594 of February.

621.397.62 : 621.372.632 **2236**

Simplified Band-III Converter.—O. E. Dzierzynski. (*Wireless World*, May 1956, Vol. 62, No. 5, pp. 221–223.) Constructional details are given of a fixed-tuned aerial filter used in conjunction with the converter described earlier (1564 of May).

621.397.62 : 621.396.82 **2237**

Parasitic Radiations from Television Receivers.—C. Egidi & F. Maggiore. (*Alta Frequenza*, Dec. 1955, Vol. 24, No. 6, pp. 470–498.) The sources of the parasitic radiations are reviewed; the local oscillator is recognized as being the most troublesome. A field-measuring set developed at Turin is described and relevant formulae for the field close to a radiator are presented. The observed radiation patterns are classified according to whether they are produced by chassis radiation only or not. Methods of reducing the parasitic radiations by suitable design are discussed.

621.397.7 : 621.325.5 **2238**

Xenon Arc Discharge Lamps.—H. W. Cumming. (*Elect. Times*, 19th Jan. 1956, Vol. 129, No. 3350, pp. 83–85.) Details are given of several types; their illumination characteristics are highly suitable for television studios, intensity being controllable without colour change.

621.397.7 : 628.972 **2239**

Television Studio Lighting.—C. L. Faudell. (*Proc. Instn Radio Engrs, Aust.*, Jan. 1956, Vol. 17, No. 1, pp. 7–12.) Basic requirements are discussed and types of lamps and accessories available and the techniques of their use are indicated.

621.397.8 : 621.372.553 **2240**

Delay Equalization of a Television System.—D. Bünemann. (*Arch. elekt. Übertragung*, Jan. 1956, Vol. 10, No. 1, pp. 10–18.) The problem is discussed on the basis of a given frequency variation of the envelope delay. A graphical method is used to design an all-pass circuit by combining elementary all-pass units in such a way that the sum of the delays of the transmission system and the all-pass units has a minimum deviation from a constant mean value.

VALVES AND THERMIONICS

621.314.63.012 **2241**

A Chart for the Evaluation of Crystal Rectifier Constants.—I. M. Templeton. (*Electronic Engng*, April 1956, Vol. 28, No. 338, p. 172.)

621.314.7 **2242**

Alloyed-Junction Transistor Development.—J. J. Ebers. (*Bell Lab. Rec.*, Jan. 1956, Vol. 34, No. 1, pp. 8–12.) A description is given of the method of producing an *n-p-n* or *p-n-p* transistor by heating a pellet of the alloying material in contact with a wafer of the base material. The properties of this type of transistor are particularly suitable for switching applications.

621.314.7 **2243**

Factors affecting Reliability of Alloy Junction Transistors.—A. J. Wahl & J. J. Kleimack. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 494–502.) Report of an investigation of the effects on Ge *p-n-p* transistors alloyed with In and *n-p-n* transistors alloyed with As-doped Pb of exposure to oxygen, water vapour and other gases. Changes of the breakdown voltage, reverse current, and current gain are produced by oxygen and water vapour in opposite senses; no observable changes were produced by pure hydrogen, nitrogen or helium. The changes produced are reversible; the true characteristic can be restored by baking in vacuum at a suitable temperature. Very high stability of characteristics can be achieved if water vapour and oxygen are completely excluded in this way.

621.314.7 + 621.385 **2244**

Transistors versus Vacuum Tubes.—D. G. Fink. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 479–482.) The relative merits of these two types of device are compared with reference to particular applications; possible future developments are briefly indicated.

621.314.7 + 621.385] : 621.375 **2245**

Comparison of Junction Transistor and Amplifier Valve.—Ledig. (See 2001.)

621.383.001.4 **2246**

Simplified Determination of the Spectral Sensitivity of Photocathodes.—C. Dufour. (*Ann. Radioélect.*, April 1955, Vol. 10, No. 40, pp. 174–181.) Methods using monochromatic filters, particularly Fabry-Pérot and multi-dielectric types, are preferred. Laboratory equipment is described and results obtained with a Ag-Cs photocathode are reported.

621.383.27 **2247**

Transit-Time Spread in Electron Multipliers.—T. D. S. Hamilton & G. T. Wright. (*J. sci. Instrum.*, Jan. 1956, Vol. 33, No. 1, p. 36.) Brief report of experiments on commercial multistage photomultipliers, demonstrating how the modulation of h.f. signals detected by the multiplier decreases as the transit-time spread increases with the reduction of overall operating voltage.

621.383.4 : 546.482.21 **2248**

Industrial CdS Photoresistors.—P. Tarbes. (*Bull. Soc. franç. Élect.*, Jan. 1956, Vol. 6, No. 61, pp. 73–82.) Properties and applications of commercially available CdS photoconductive cells are described.

621.383.4 : 546.817.221 : 621.396.822 **2249**

On the Specific Noise of Lead Sulfide Photodetectors.—B. Wolfe. (*Rev. sci. Instrum.*, Jan. 1956, Vol. 27, No. 1, pp. 60–61.) A brief note giving experimental results for several commercial PbS cells.

621.383.5 : 537.311.33 **2250**

GaAs Photo-element.—R. Gremmelmaier. (*Z. Naturf.*, June 1955, Vol. 10a, No. 6, pp. 501–502.) According to Rittner's findings (1682 of 1955) GaAs, which has an energy gap of 1·38 eV, should be a highly efficient converter for solar energy. Some measurements on a *p-n* junction made of polycrystalline material are briefly reported; higher efficiency is to be expected if carefully prepared single-crystal material is used.

621.385 : 621.318.57 **2251**

Keep-Alive Instabilities in a TR Switch.—T. J. Bridges, P. O. Hawkins & D. Walsh. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 535–538.) The risk of the keep-alive discharge being accidentally extinguished as a result of glow-to-arc transitions is lessened by providing two keep-alive electrodes. See also 2252 below.

621.385 : 621.318.57.032.2 **2252**

Electrode Deterioration in "Keep-Alive" Discharges in Transmit-Receive Switches.—D. Walsh, A. W. Bright & T. J. Bridges. (*Brit. J. appl. Phys.*, Jan. 1956, Vol. 7, No. 1, pp. 31–35.) An investigation of the behaviour of electrode materials in a discharge in a medium containing water vapour is described. Most common stable metals and one semiconducting ceramic material were tried. Normal- and abnormal-glow conditions in t.r. switches are considered separately; the former lead to long life, while the latter give freedom from oscillations.

621.385.004 **2253**

Sampling of Vacuum Valves for Acceptance Inspection.—M. D. Indjoudjian & J. Oswald. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 65–72.) Sampling methods adopted by the French Post Office are described; these have led to saving in testing time without loss of efficiency. The mathematical basis of the technique is given.

621.385.004 **2254**

Utilization of Electronic Valves on [French] **Long-Distance Underground Lines.**—P. Bassole & J. Eldin. (*Câbles & Transm.*, Jan. 1956, Vol. 10, No. 1, pp. 53–64.) A study of the methods used for accounting, inspection and analysing replacements.

621.385.029.6 + 621.372.029.6 **2255**

Report of Advances in Microwave Theory and Techniques—1954.—King. (See 1952.)

621.385.029.6 **2256**

A Graphical Method for investigating Travelling-Wave Valves.—V. M. Lopukhin & Yu. D. Samorodov. (*Zh. tekh. Fiz.*, July 1955, Vol. 25, No. 7, pp. 1265–1275.) A method is proposed, by means of which it is possible to investigate dispersion equations of any algebraic degree. The method is applied to a study of travelling-wave and two-beam amplifiers for a wide range of values of the parameters. Analysis of the interaction between the field and the space charge yields solutions including one corresponding to a wave

travelling in the negative direction. Curves of the phase velocity of the waves are plotted for various operating conditions.

621.385.029.6 **2257**

Using Travelling-Wave Tubes.—R. E. White. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 144–145.) The suitability of travelling-wave valves as amplitude modulators, limiters and mixers is indicated by reference to the valve characteristics.

621.385.029.6 : 538.566 : 537.56 **2258**

Growing Electric Space-Charge Waves and Haeff's Electron-Wave Tube.—J. H. Piddington. (*Phys. Rev.*, 1st Jan. 1956, Vol. 101, No. 1, pp. 14–16.) Analysis is presented indicating that the explanation of wave growth presented e.g. by Haeff (1825 of 1949) is not the true one; an alternative explanation based on trapping of electrons between potential troughs of a space-charge wave (2030 above) is considered more plausible.

621.385.029.6 : 621.376.23 **2259**

Microwave Detector.—J. T. Mendel. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 503–508.) The detector described is based on the 'stop-band' velocity-discriminator properties of periodic magnetic focusing systems used in association with travelling-wave valves [2546 of 1954 (Mendel et al.)]. The focusing system surrounds a drift tube following the wave-slowing circuit, and the beam electrons are sorted according to their r.f. velocity modulation, thus the collector current is a function of the microwave power. A numerical calculation for an arrangement comprising 20 magnetic lenses indicates that a power level of 0·36 mW corresponds to a velocity change of 0·76%. Other possible applications of the device include a high-level mixer.

621.385.032.216.2 : 621.37 **2260**

Heater-Cathode Leakage.—(*Tele-Tech & Electronic Ind.*, Jan. 1956, Vol. 15, No. 1, pp. 56–57 . . 110.) Various mechanisms by which current leakage takes place between an oxide cathode and its heater are described; observation and test methods are indicated. The effects on circuit performance are discussed with particular reference to a class-A amplifier, a multivibrator and a f.m. demodulator.

621.385.3 **2261**

Some New Types of High-Voltage Low-Current Vacuum Triodes.—R. Feinberg & K. C. Burn. (*Electronic Engng*, April 1956, Vol. 28, No. 338, pp. 160–162.) Characteristics are given of valves suitable for use as variable high-voltage resistors and in direct-voltage control and stabilization.

621.385.832 **2262**

Deposition and Removal of Electric Charges on Insulators by Secondary Emission: Part 1.—M. Barbier. (*Ann. Radioélect.*, April 1955, Vol. 10, No. 40, pp. 182–214.) A detailed theoretical study is presented of the processes involved in recording signals in the form of charges on insulator plates in cathode-ray tubes; the field distributions and secondary-electron paths are analysed for some simple configurations. Possible accumulations of space charge are taken into account, and estimates are made of the amount of charge that can be deposited, the limits of resolution to be expected, the accumulation factor, and the beam intensity required for writing or reading.

621.385.832 **2263**

Permanent-Writing Cathode-Ray Recorder.—L. N. Heynick, R. J. Wohl & D. H. Andrews. (*Electronics*, April 1956, Vol. 29, No. 4, pp. 148–149.) A special c.r. tube of rectangular cross-section has a linear array of styli projecting inwards and outwards through the end face. The beam is swept across the inner ends of the styli by a signal, and a suitable co-operating potential is applied to an external electrode which serves also to keep a moving sheet of recording paper pressed against the outer ends of the styli. Various applications of the device are mentioned.

621.385.832(083.7) **2264**

I.R.E. Standards on Electron Devices: Definitions of Terms related to Storage Tubes, 1956.—(*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 521–522.) Standard 56 I.R.E. 7. S1.

621.387 **2265**

Thyratron R.M.S. Current Ratings.—(*Mullard tech. Commun.*, Dec. 1955, Vol. 2, No. 16, pp. 152–156.) The increased ratings possible with delayed firing angles are shown.

MISCELLANEOUS

621.3.002.2 **2266**

New Developments in Automatic Production for Electronics.—(*Elect. Mfg*, April 1955, Vol. 55, No. 4, pp. 126–131.) An illustrated report on progress, including descriptions of a machine for inserting 24 different components into a printed-circuit board, an automatically programmed punching machine and an adaptation of the Tinkertoy technique.

621.37/.38].004.5/.6 **2267**

Increasing the Reliability of Electronic Equipment by the Use of Redundant Circuits.—C. J. Creveling. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 509–515.) Conditions are considered for equipment comprising a large number of elements, such as that of bombers. Equations are derived relating reliability to the number of circuit elements in the redundant and nonredundant cases; examples indicate the degree of improvement attainable. The improvement effected in this way is increased by arranging for regular maintenance; attention is drawn to the fact that the redundancy obscures the faulty condition.

621.37/.38].004.5/.6 **2268**

A Systems Approach to Electronic Reliability.—W. F. Luebbert. (*Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, pp. 523–528.) A rationale for the development of reliable systems is presented in the form of a check-list.

621.39 **2269**

Radiotechnical Literature [in the U.S.S.R.] **in 1956.**—V. Shipov, A. Smirnov & P. Popov. (*Radio, Moscow*, Jan. 1956, No. 1, pp. 16–17.) Brief survey of the publishing programme of three leading publishing houses.

621.39(083.7) **2270**

Symbols used in Electrical Communication Engineering.—H. Meinke. (*Nachrichtentech. Z.*, Jan. 1956, Vol. 9, No. 1, pp. 39–46.) German draft standard DIN 1344, October 1955, is presented and discussed.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534-16 : 061.3 **2271**

Conference on 'Sound and Vibrations in Solid Bodies', Göttingen, 19th–22nd April 1955.—(*Akust. Beihefte*, 1956, No. 1, pp. 49–227.) The text is given of 35 papers, the majority in German and the remainder in English; English, French and German summaries are provided.

534.121.1 **2272**

On the Flexural Vibrations of Circular and Elliptical Plates.—W. R. Callahan. (*Quart. appl. Math.*, Jan. 1956, Vol. 13, No. 4, pp. 371–380.) The frequency equations for the normal modes of vibration are studied.

534.2-8 **2273**

A Simple Method for the Visualization of Ultrasonic Fields.—Y. Torikai & K. Negishi. (*J. phys. Soc. Japan*, Dec. 1955, Vol. 10, No. 12, p. 1110.) A method using ordinary photographic paper is outlined.

534.2-8-14 **2274**

The Propagation of Ultrasonics in Suspensions of Particles in a Liquid.—J. Busby & E. G. Richardson. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 193–202.) Measurements at frequencies between 1 and 10 Mc/s are reported, on suspensions of glass spheres (monodisperse) and silica particles (polydisperse) of radius 8–100 μ.

534.6 **2275**

An Apparatus for measuring Air-Flow Resistance of Acoustical Materials.—H. J. Sabine. (*ASTM Bull.*, Jan. 1956, No. 211, pp. 29–32.)

621.395.616 **2276**

Artificial Stabilization of the MR-103 Type Condenser Microphone.—T. Hayasaka, K. Masuzawa & M. Suzuki. (*Rep. elect. Commun. Lab., Japan*, Oct. 1955, Vol. 3, No. 10, pp. 59–60.) Titanium is used as diaphragm material on account of its strength. To obtain the same stability as would be provided by aging for a year or more at normal temperature, it is only necessary to heat the microphone for 5 hours at 200°C.

621.395.623.7 **2277**

Miniature Loudspeakers for Personal Radio Receivers.—J. C. Bleazey, J. Preston & E. G. May. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 57–67.) Two experimental loudspeakers are described in which the cone housing and the magnet occupy the same space, thus reducing the overall depth. Directional characteristics, distortion and frequency response are similar to those of conventionally constructed loudspeakers.

621.395.623.8 : 621.396.975 **2278**

Wireless Sound Systems.—C. W. Hargens. (*J. Franklin Inst.*, Nov. 1955, Vol. 260, No. 5, pp. 351–356.) Description of a system installed at the Franklin Institute in a hall with a reverberation time of several seconds. Miniature transistor-equipped receivers are used. The carrier frequency is between 550 and 1 600 kc/s, the particular value being chosen to meet a Federal Communications Commission requirement regarding field strength at distance $\lambda/2$. Any public-address amplifier can serve as modulator. The transmitter aerial is a long conductor making a loop round the hall; the receiver aerials are ferrite-core types.

621.395.625.2 : 621.396.712.3 **2279**

Reproducing Equipment for Fine-Groove Records.—G. V. Buckley, W. R. Hawkins, H. J. Houlgate & J. N. B. Percy. (*B.B.C. Engng Div. Monographs*, Feb. 1956, No. 5, pp. 1–19.) Description of a reproducing desk designed to facilitate the location of desired excerpts.

621.395.625.3 **2280**

Mechanical Aspects of Magnetic-Recorder Design.—G. P. Bakos. (*Tijdschr. ned. Radiogenoot.*, Jan. 1956, Vol. 21, No. 1, pp. 17–37. In English.) A review of modern practice, covering tape, sheet and disk machines, as well as multichannel equipment.

AERIALS AND TRANSMISSION LINES

621.315.212.1.011.3 **2281**

The Inductance of Two Elliptic Tubes.—E. E. Jones. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, pp. 56–58.) The inductance is calculated of cables comprising two confocal or concentric elliptic tubes of nonmagnetic material.

621.372 **2282**

An Investigation of the Properties of Radial Cylindrical Surface Waves launched over Flat Reactive Surfaces.—W. M. G. Fernando & H. E. M. Barlow. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 307–318.) Experiments were made using a vertical dipole source arranged at various heights above the centre of a horizontal metal disk inductively loaded either by means of a thin dielectric coating or by forming a series of concentric corrugations. Theory developed by Cullen (22 of 1955) is applied; the observations are in good agreement with the theoretical predictions both as regards field distributions and launching efficiency, and it is confirmed that a launching efficiency approaching 80% is attained for a particular height of the dipole.

621.372.2 : 621.317.34 : 621.317.729 **2283**

An Investigation into some Fundamental Properties of Strip Transmission Lines with the Aid of an Electrolytic Tank.—J. M. C. Dukes. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 319–333.) A technique was developed by means of which the line parameters could be rapidly evaluated with a useful degree of accuracy for a range of dimensions for which rigorous solutions by direct analysis are not readily available, this range including lines with characteristic impedance between 20 and 150Ω. The investigations covered the balanced-parallel-plate line, the strip-above-ground line, and the sandwich, or tri-plate, line. The validity of formulae derived by other workers is discussed and new methods for calculating the line parameters are developed. The results indicate that the dominant mode in a microstrip line is closer to the TEM mode than has been supposed hitherto. The sandwich line has some theoretical advantages over the strip-above-ground line, but these may be offset by practical disadvantages.

621.372.2 : 621.385.029.6 **2284**

Interpretation of Wavelength Measurements on Tape Helices.—C. P. Allen & G. M. Clarke. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 171–176.) An unexpected region of dispersion observed by Sensiper (1247 of 1955) is found to be due to the finite length of the helix. The effect may be important in relation to the design of travelling-wave devices.

621.372.8 **2285**

A New Treatment of Lossy Periodic Waveguides.—P. N. Butcher. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 301–306.) The new treatment is based on introduction of a 'complex Q factor', Q_e; the propagation coefficient of a mode in a lossy guide at the frequency ω is equal to that of the corresponding mode in a loss-free guide at the frequency $\omega(1 - j/2Q_e)$. An explicit formula is given for Q_e for the case of small losses.

621.372.8 **2286**

Junction Admittance between Waveguides of Arbitary Cross-Sections.—E. D. Farmer. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 145–152.) If the dominant modes of the adjoining waveguides have similar patterns over the coupling aperture, the junction can be represented approximately by a two-terminal network. A general definition of characteristic impedance is introduced enabling the junction to be regarded as an 'impedance mismatch' together with a shunt susceptance 'junction effect'. The limits of applicability of the theory are assessed by making calculations for some special cases, including a junction between a rectangular and a hexagonal guide.

621.372.8 **2287**

Microwave Propagation in Anisotropic Waveguides.—A. E. Karbowiak. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 139–144.) Analysis is presented based on the surface-impedance approach developed previously (3484 of 1955). The corrugated surface and the conducting helix are two particular cases of the anisotropic surface considered. All E and H_a modes are shown to be stable whatever the orientation of the principal axes of the surfaces; higher-order H modes are unstable unless the principal axes coincide with the coordinate axes of the surface, but a certain combination of H waves ('spinning H wave') can be propagated.

621.372.8 : 538.221 **2288**

Attenuation and Permeability of Ferromagnetic Waveguides between 9 000 and 9 675 Mc/s.—J. Allison & F. A. Benson. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 205–211.) "Measurements of the attenuations produced by air-filled rectangular waveguides of nickel, mild steel, mumetal, radiometal and rhometal have been made in the frequency range 9 000–9 675 Mc/s. The permeabilities of the materials have been determined from these measurements and a knowledge of the roughness and resistivity of each waveguide internal surface. The effects of temperature on the h.f. permeabilities have also been studied, and some qualitative results are included on the effect of superimposing a steady magnetic field on the h.f. one."

621.372.8 : 538.221 : 538.6 **2289**

Equation of Circularly Polarized Waves in a Gyro-paramagnetic Medium.—J. Soutif-Guicherd. (*C. R. Acad. Sci., Paris*, 12th March 1956, Vol. 242, No. 11, pp. 1418–1421.) Analysis is outlined for propagation in a waveguide containing a medium whose permeability is represented by a tensor. The propagation coefficient is expressed in a form susceptible to limited development for the case of a paramagnetic medium; the field equations for a circularly polarized wave are derived.

621.372.8 : 621.3.012.8 **2290**

The Calculation of the Equivalent Circuit of an Axially Unsymmetrical Waveguide Junction.—R. E. Collin & J. Brown. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 121–128.)

621.372.8 : 621.318.134 **2291**

Temperature Behavior of Ferrimagnetic Resonance in Ferrites located in Waveguide.—B. J. Duncan & L. Swern. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 209–215.) The investigation described is an extension of that reported previously (2192 of 1955). Measurements were made on MgMn and NiZn ferrites over the temperature range from 25°C to the Curie point in each case. Temperature variation of the resonance-line width and the apparent gyromagnetic ratio was observed. The effect on the microwave transmission properties is discussed.

621.372.8 : 621.372.2 **2292**

The Excitation and Propagation of E_{on} Modes in a Circular Waveguide with Coaxial Lines at Input and Output.—A. Sander. (*Arch. elekt. Übertragung*,

Feb. 1956, Vol. 10, No. 2, pp. 77–85.) Analysis is presented in which the concepts of 'field' and 'hybrid' quadripoles and the corresponding matrices are introduced.

621.372.8 + 621.396.677.85] : 621.372.43 **2293**

The Design of Quarter-Wave Matching Layers for Dielectric Surfaces.—R. E. Collin & J. Brown. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 153–158.) "A quarter-wave transformer to match the junction between an empty waveguide and one completely filled with a dielectric may be made from a waveguide partially filled with dielectric. A method of designing such a transformer, when all the waveguides have the same cross-section, is described, and experimental results are given to show that this design is satisfactory. A similar arrangement can be used to match the surfaces of a dielectric lens: slots are cut on the surface and design information is given for slots parallel or perpendicular to the electric field of the wave incident on the surface. Measured reflection coefficients for a surface matched in this way are in good agreement with calculated values."

621.396.67 : 001.4 **2294**

Russian Antenna Terminology.—G. F. Schultz. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, p. 692.) A short list of representative terms is given with the English equivalents.

621.396.674.3 : 621.397 **2295**

Wide-Band Television Aerials.—M. G. O'Leary. (*Wireless World*, June 1956, Vol. 62, No. 6, pp. 288–291.) An illustrated review of current North American practice in the design of combined aerial systems for reception in bands I and III.

621.396.676.012.12 **2296**

The Radiation Pattern of an Antenna mounted on a Surface of Large Radius of Curvature.—J. R. Wait. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, p. 694.) Calculations are made of the radiation pattern of a dipole or a slot on a conducting sphere of large radius, by applying van der Pol-Bremmer theory.

621.396.677.71 : 621.397.61 **2297**

The Omniguide Antenna—an Omnidirectional Waveguide Array for U.H.F.-Television Broadcasting.—O. M. Woodward, Jr, & J. Gibson. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 13–36.) Detailed description of an aerial comprising an octagonal-section inner waveguide surrounded by eight ridged waveguides with offset longitudinal slots. The picture and sound signals are diplexed, using either a combining filter and single feed line or a separate coaxial-line sound input with a special diplexer. The construction is of aluminium with a thin covering of fibre glass for weather protection.

621.396.677.85 **2298**

Successive Approximation and Expansion Methods in the Numerical Design of Microwave Dielectric Lenses.—R. L. Sternberg. (*J. Math. Phys.*, Jan. 1956, Vol. 34, No. 4, pp. 209–235.)

AUTOMATIC COMPUTERS

681.142 **2299**

The Short Electronic Analogue Computer.—R. J. A. Paul. (*Overseas Engr*, Jan. & Feb. 1956, Vol. 29, Nos. 337 & 338, pp. 205–208 & 251–252.) Description of the design and operation of a general-purpose computer designed for quantity production and capable of single-shot and repetitive operation.

681.142 **2300**

Tridac, a Large Analogue Computing Machine.—F. R. J. Spearman, J. J. Gait, A. V. Hemingway & R. W. Hynes. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 375–390. Discussion, pp. 390–395.) A detailed description; a shorter account was abstracted previously (943 of 1955).

681.142 **2301**

Function Generators based on Linear Interpolation with Applications to Analogue Computing.—E. G. C. Burt & O. H. Lange. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 51–58.) By using suitable combinations of diode circuits and high-gain feedback amplifiers it is possible to generate functions without restriction to monotonic characteristics. Experimental results are presented for a sin x generator in which the error is about $1\frac{1}{2}\%$ of the maximum output.

681.142 **2302**

Construction and Method of Operation of Modern Integrating Equipment [differential analysers].—H. Hoffmann. (*Elektrotech. Z., Edn A*, 11th Jan. & 1st Feb. 1956, Vol. 77, Nos. 2 & 3, pp. 41–52 & 77–83.) General principles are discussed and a detailed description is given of an installation in Germany. The results are presented to three or four significant figures by counter mechanisms, and in the form of curves on function benches. Curves of empirical functions are dealt with by photoelectric scanning. Errors do not exceed $0{\cdot}1\%$ – 1%.

681.142 : [621.314.63 + 621.314.7 **2303**

Engineering Multistage Diode Logic Circuits.—B. J. Yokelson & W. Ulrich. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, p. 1079.) Design of computers using crystal diodes and transistors is discussed. Transistor input circuits directly coupled to multistage logic circuits may avoid the need for intermediate amplifier stages.

681.142 : 621.314.7 **2304**

Transistor Circuits for Analog and Digital Systems.—F. H. Blecher. (*Bell Syst. tech. J.*, March 1956, Vol. 35, No. 2, pp. 295–332.) A summing amplifier, an integrator and a voltage comparator using junction transistors are described, together with a voltage encoder made up from them, for translating voltages into equivalent time intervals for analogue-to-digital conversion.

681.142 : 621.314.7 **2305**

An Experimental Transistorized Calculator.—G. D. Bruce & J. C. Logue. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, pp. 1044–1048.) The machine is functionally identical with the IBM Type-604 calculating punch, but the valves are completely replaced by transistors and Ge diodes.

681.142 : 621.37 **2306**

An A.M.-A.M. Multiplier.—L. Lukaszewicz. (*Bull. Acad. polon. Sci., Classe 4*, 1955, Vol. 3, No. 3, pp. 145–148. In English.) A relatively simple purely electronic multiplier circuit for differential analysers is described. Working with an upper frequency limit of 10 kc/s for both factors, accuracy is within about 0·3% of full scale.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.011 **2307**

Abac of the Function $2J_1(z)/zJ_0(z)$ for studying the Initial Complex Permeability of Circular-Cross-Section Conductors at High Frequency.—J. Benoit

& E. Naschke. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 77–78.) The impedance of the conductor is measured and the parameter z is then found from the abac, using a known formula; the complex permeability μ is then derived using a given relation between μ and z. This abac supplements that presented by Prache (1875 of 1950), which was not applicable to good conductors.

621.3.011 : 621.396.822 **2308**

Physical Sources of Noise.—J. R. Pierce. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 601–608.) The principal types of electrical noise encountered in circuits and valves are identified and the mechanisms giving rise to them are discussed. Equations used to represent noise phenomena are derived.

621.3.011.21 : 621.375.13 **2309**

The Impedance Concept.—C. G. Mayo & J. W. Head. (*Wireless Engr*, April & May 1956, Vol. 33, Nos. 4 & 5, pp. 96–102 & 121–128.) Impedances and associated transfer functions are expressed in terms of a variable $p = \alpha + j\omega$ which is closely associated with time differentiation. The fundamental properties of the 'p world' are discussed. A general condition for an algebraic equation to be free from roots with positive real parts is obtained; a network whose characteristic equation has this property is stable. Conditions are deduced for a system to have a damping rate at least equal to a specified value. The effect of adding terms in p^4 and p^5 on the roots of a given cubic in p is examined. The effect on the gain and maximum obtainable feedback of the addition of a 'step circuit' to a three-stage RC amplifier is considered in detail.

621.3.066.6 : 621.318.5 **2310**

Properties and Comparative Tests on Relay Contacts.—T. Gerber. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st Jan. 1956, Vol. 34, No. 1, pp. 1–26. In French.) See 2545 of 1955.

621.314.222 : 621.397.6 **2311**

Toroidal Transformers pass Video Bandwidths.—G. W. Gray. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 150–153.) Television video transformers are wound on supermalloy tape-wound toroids having a low-frequency permeability of 70 000 diminishing with increasing frequency; a bandwidth of 6 Mc/s is obtainable. These transformers may be used for matching a 50-Ω coaxial cable and for interstage coupling in transistor video amplifiers.

621.314.222.012.3 **2312**

[Power-] **Transformer Design Chart.**—R. Lee & N. E. Mullinix. (*Trans. Inst. Radio Engrs*, April 1955, No. PGCP-3, pp. 10–14; *Electronics*, April 1956, Vol. 29, No. 4, pp. 184–186.) The chart gives data for designing two-winding 60-c/s l.v. transformers.

621.316.8.029.6 : 621.315.212 : 621.372.22 **2313**

The Theory and Design of Coaxial Resistor Mounts for the Frequency Band 0 – 4 000 Mc/s.—I. A. Harris. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 1–10.) A design is described in which the resistive inner conductor has uniform diameter while the outer conductor has a tractrix profile. Lead-in cones are designed to avoid discontinuity at the connections. Experimental results indicate that the impedance is within 1% of the d.c. resistance, with an extremely small phase angle, at all frequencies up to the highest measured, namely 3·45 kMc/s.

621.316.86 : 546.281.26 **2314**

The Operating Mechanism of Voltage-Dependent Silicon-Carbide Resistors.—K. Zückler. (*Z. angew. Phys.*, Jan. 1956, Vol. 8, No. 1, pp. 34–40.) Measurements on aggregates of SiC particles, such as pressed powder, show how thermal effects depend on grain size and the duration of the current pulse. Thermal and field effects can be separated by reference to resistance/voltage characteristics at different temperatures for single contacts between crystals or between a crystal and a metal knife-edge.

621.316.86 : 621.3.012.8 **2315**

The Specification of the Properties of the Thermistor as a Circuit Element in Very-Low-Frequency Systems.—C. J. N. Candy. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 398–409.) "An analysis based on sinusoidal applied voltages shows that a conductor whose resistance is a function of temperature may be represented by an equivalent circuit having a semicircular impedance locus. An expression for the distortion of the waveform is also obtained, and this is found to be small provided that the alternating current is less than a quarter of the steady polarizing current which flows in the conductor. The impedance loci of a bead-type thermistor are plotted by means of a null technique. A typical impedance varied from a negative resistance of 3 000 ohms at very low frequencies to a pure inductance of 2 000 H at 0·3 c/s and then to a positive resistance of 5 000 ohms at high frequencies. The use of the equivalent circuit is illustrated by designing phase-shift networks suitable for use in the stabilizing of very-low-frequency control systems. These circuits may be used in systems where either a.c. or d.c. data transmission is employed."

621.316.86.002.2 **2316**

Problems Encountered and Procedures for obtaining Short-Term Life Ratings on Resistors.—W. T. Sackett, Jr. (*Trans. Inst. Radio Engrs*, April 1955, No. PGCP-3, pp. 15–29.) Account of investigations made at the Battelle Memorial Institute on the extent to which length of life must be sacrificed when composition resistors are operated at high temperature. A machine system for handling the data is described.

621.318.435.3 : 621.316.722 **2317**

A.C. Controlled Transductors.—A. G. Milnes & T. S. Law. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 81–94.) Analysis of the behaviour of the single-core auto-self-excited transductor is made for the condition when the control circuit has finite resistance. A.c. control of full-wave transductors and some push-pull circuits with half-wave and full-wave outputs are referred to.

621.318.435.3.011.6 **2318**

The Residual Time-Constant of Self-Saturating (Auto-Excited) Transductors.—U. Krabbe. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 71–80.) Theoretical and experimental evidence is presented indicating that the main winding of a self-saturating transductor influences the time constant for small signals to an extent dependent on the blocking intervals of the rectifiers and on the main-winding resistance. The blocking interval is in turn dependent on the output amplitude; this is consistent with the normal experience that transductor response becomes faster as the output increases.

621.318.57 : 621.374.32 : 621.387 **2319**

A Digital Differential.—W. H. P. Leslie. (*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 190–193.) A simultaneous bidirectional counter circuit is described in which a dekatron valve is used to indicate the running difference in count between two independent pulse trains; the circuit can also be used in frequency- and speed-control applications.

621.318.57 : 621.397.61 **2320**

Electronic Switches for Television.—Spooner. (See 2551.)

621.319.4 **2321**

The Effective Leakage Resistance of Several Types of Capacitors.—R. W. Tucker & S. D. Breskend. (*Trans. Inst. Radio Engrs*, April 1955, No. PGCP-3, pp. 3–9.) A rapid method of measuring leakage resistance based on rate of charge is described. Variation of leakage resistance with time was measured for commercial capacitors of values ranging from 0·001 to 0·033 μF, with various dielectrics, at temperatures ranging from 73° to 212°F in most cases. The best d.c. properties were exhibited by a capacitor having a polytetrafluoroethylene dielectric.

621.319.4 : 621.314.63 **2322**

A Variable-Capacitance Germanium Junction Diode for U.H.F.—Giacoletto & O'Connell. (See 2559.)

621.319.4 : 621.372.542.2 : 621.318.134 **2323**

Cascaded Feedthrough Capacitors.—H. M. Schlicke. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 686–691.) By interspersing lossy ferrite washers between the stacked ceramic disks of capacitors of the type described previously (1279 of 1955), the filtering properties for v.h.f. and u.h.f. are greatly improved; such constructions are thus useful for miniaturized low-pass filters. Properties of suitable ferrites are discussed.

621.37/.39(083.74) **2324**

National Bureau of Standards Preferred Circuits Program.—J. H. Muncy. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, pp. 1088–1090.) See 342 of February.

621.372 **2325**

Invariance and Mutual Relations of Electrical Network Determinants.—I. Cederbaum. (*J. Math. Phys.*, Jan. 1956, Vol. 34, No. 4, pp. 236–244.) Work by earlier authors, e.g. Tsang (48 of 1955), is generalized. The basic values of the impedance and admittance determinants are connected by a simple relation involving the determinant of the branch parameter matrix.

621.372 **2326**

Nonlinear Network Problems.—G. Birkhoff & J. B. Diaz. (*Quart. appl. Math.*, Jan. 1956, Vol. 13, No. 4, pp. 431–443.) General analysis is presented for flow problems; a number of theorems are proved. Relaxation methods are used.

621.372 : [621.385.3 + 621.314.7 **2327**

Transformation of the Matrices of Generalized Admittances (Impedances) for Various Triode Connections.—E. I. Adirovich. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1436–1443.) The usual three sets of connections for triode valves and for transistors are examined.

621.372.4/.5 : 621.3.011 **2328**

The Correlation between Decay Time and Amplitude Response.—S. Demczynski. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 64–70.) An investigation is made of the relation between (*a*) the decay time and the delay time of the indicial response, and (*b*) the bandwidth and peak values of the steady-state amplitude response, for various minimum-phase lumped-parameter networks. Formulae are derived expressing the functional relation between decay time and the ratio f_3/f_6, where f_3 is the bandwidth at -3 dB and f_6 that at -6 dB. A formula for delay time is derived which is valid for multistage circuits.

621.372.41 : 621.3.015.3 **2329**

Energy Considerations for Growth and Decay Transients in a Simple Resonator Circuit.—G. Čremošnik. (*Arch. elekt. Übertragung*, Feb. 1956, Vol. 10, No. 2, pp. 65–72.) Analysis is presented for a series *RLC* circuit, values of current, voltage, etc., being determined in terms of the characteristic resistance $K = \sqrt{L/C}$. The solution of the differential equations is simplified by taking the energy of the circuit as the basic time variable, since this is fixed by the initial conditions.

621.372.412 **2330**

40–50-Mc/s Overtone Quartz Crystal Units.—K. Takahara, M. Kobayashi, I. Ida & Y. Arai. (*Rep. elect. Commun., Lab., Japan*, Oct. 1955, Vol. 3, No. 10, pp. 46–50.) The experimental crystal described is a circular plate carrying an evaporated metal film, held at diametrally opposite points by springs attached to the lead terminals. Details are given of the lapping process and the frequency adjustment.

621.372.5 **2331**

The Most Elementary Geometrical Representation of Loss-Free Linear Quadripoles.—J. de Buhr. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 80–84.) "It is possible to describe impedance transformations in lossless and linear quadripoles by geometrical quantities and by cascade parameters. An unambiguous geometrical representation in the form of a system of two transformation lines equivalent to the one transformation line of an impedance transformation is also possible and this leads to a new and unified method of representing the three different transformations by linear quadripoles and by elliptical and hyperbolic quadripoles as well as by the parabolic reactance quadripole. This gives for the linear quadripoles an intuitive and elementary form of treatment which has proved to be very useful for the solution of many quadripole problems. An impedance transformation using the images with respect to two transformation lines is given for the example of a parabolic reactance quadripole such as a series capacity."

621.372.542.4 : 621.396.41 **2332**

Interference Spectra and Aerial Filters. A Note on the Problem of the Simultaneous [two-way] **Operation of Directional Radio Systems with Pulse Modulation.**—A. Kuch. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 63–69.) The design of continuously tunable multi-circuit diplexing filters for u.h.f. communication systems is discussed. A frequency separation of 75 Mc/s is assumed between the associated transmitter and receiver, and the asymmetrical nature of the transmitter spectrum is taken into account.

621.373 : 621.316.729 **2333**

Theory of Synchronization of Self-Oscillations of Arbitrary Form.—I. I. Minakova & K. F. Teodorchik. (*C. R. Acad. Sci. U.R.S.S.*, 1st Feb. 1956, Vol. 106, No. 4,

pp. 658–660. In Russian.) Analysis is given for an oscillation containing only a few harmonic components. The effect of applying a sinusoidal force, of a frequency near the third harmonic, is investigated by a method involving the use of Fourier-series coefficients.

621.373.42 : 621.316.729 **2334**

Discrimination of a Synchronized Oscillator against Interfering Tones and Noise.—D. G. Tucker & G. G. Jamieson. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 129–138.) The discrimination exercised by a nonlinear regenerative tuned circuit against unwanted signals accompanying a synchronizing tone is due partly to the frequency response of the system and partly to the nonlinearity, provided that the synchronizing signal has a greater amplitude than the unwanted signals after allowing for frequency response. The phenomenon is analysed, and measurements of discrimination against noise are reported; the degree of discrimination can be very great when the synchronizing frequency is very close to the natural frequency of the circuit. When the synchronizing tone is absent or is not dominant there is no reduction of the interference intensity or bandwidth.

621.373.421 **2335**

A Wide-Range *RC* Phase-Shift Oscillator.—W. Fraser. (*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 200–202.) An oscillator with a frequency range from below 1 c/s to over 100 kc/s is described; d.c. coupling is used. A polyphase version is also described.

621.373.421 + 621.375.23] : 621.385.3.029.6 **2336**

A Grounded-Grid Valve System with High Stability Characteristics.—Exley & Young. (See 2589.)

621.373.421.11 **2337**

Frequency Stability of *LC* Oscillators with Large Grid and Anode Capacitances.—J. Groszkowski. (*Bull. Acad. polon. Sci., Classe* 4, 1955, Vol. 3, No. 3, pp. 149–155. In English.) General analysis is given for the Clapp circuit. Various factors affecting the frequency, and the optimum distribution of instability components among the circuit elements and supply voltages are discussed. See also 3170 of 1954 (Clapp).

621.373.43/.44 **2338**

The Generation and Application of Rectangular Pulses.—R. S. Sidorowicz. (*A.T.E.J.*, Jan. 1956, Vol. 12, No. 1, pp. 23–42.) A survey of various known techniques, covering both relaxation oscillators and monostable circuits. A delay-line pulse generator, a free-running multivibrator and a cathode-coupled monostable multivibrator are discussed in detail. The suitability of a valve for switching applications can be estimated on the basis of a figure of merit given by the ratio between the mutual conductance g_m and the total interelectrode and stray capacitance. Transition times are about 30 mμs for circuits using high-g_m double triodes or pentodes and of the order of 100 mμs for circuits with low-g_m valves. 49 references.

621.373.431 **2339**

Study of a Flip-Flop with Four Positions of Equilibrium by the Methods of Topological Analysis.—L. Sideriades. (*C. R. Acad. Sci., Paris*, 19th & 26th March 1956, Vol. 242, Nos. 12 & 13, pp. 1583–1586 & 1704–1707.) Analysis is presented in general terms for a two-stage circuit, assuming square-law valve characteristics. Three possible states identified are (*a*) static, (*b*) dynamic, and (*c*) impulse. The Eccles-Jordan and multivibrator circuits are particular cases. An experimental circuit has been designed; its performance agreed well with the predictions.

621.373.431.1 : 621.314.7 **2340**

Multivibrator Circuits using Junction Transistors.—A. E. Jackets. (*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 184–189.) Conventional circuits operating predictably at frequencies up to at least 10 kc/s are described.

621.373.44 : 621.387 **2341**

Reduction of the Minimum Striking Voltage of Hydrogen Thyratrons.—A. E. Barrington. (*Electronic Engng*, May 1956, Vol. 28, No. 339, p. 219.) An auxiliary tripping circuit is described by means of which the output voltage of a line-type thyratron pulse generator is made continuously variable from 0–20 kV.

621.373.52 : 621.398 **2342**

A Temperature-Stable Transistor V.C.O. [voltage-controlled oscillator].—F. M. Riddle. (*Trans. Inst. Radio Engrs*, Nov. 1954, No. PGRTRC-2, pp. 11–15. Abstract, *Proc. Inst. Radio Engrs*, April 1955, Vol. 43, No. 4, p. 514.) An oscillator for telemetry purposes is described.

621.375.225.029.3 **2343**

Cascode A.F. Amplifier.—L. B. Hedge. (*Wireless World*, June 1956, Vol. 62, No. 6, pp. 283–287.) A cathode-coupled phase inverter circuit using cascode-connected twin triodes is described, as part of a high-fidelity a.f. amplifier which does not require a specially designed output transformer.

621.375.3.012 **2344**

Analysis of a Differential Magnetic Amplifier with Flux Reset Control.—C. A. Belsterling. (*J. Franklin Inst.*, Dec. 1955, Vol. 260, No. 6, pp. 485–505.)

GENERAL PHYSICS

53.05 **2345**

The Smoothing of Non-formulated Experimental Laws by an Averaging Operation involving No Spurious Deviations.—P. Vernotte. (*C. R. Acad. Sci., Paris*, 26th March 1956, Vol. 242, No. 13, pp. 1697–1699.) A section of an experimental curve comprising M points is assimilated to a second-degree polynomial and the required ordinates are hence calculated without introducing spurious undulations.

530.152.15 **2346**

A Simplified Mathematical Approach to Hysteresis Losses.—H. L. Armstrong. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, p. 1060.) The hysteresis loop such as a normal B/H curve is approximated by an ellipse, features resulting from harmonics (i.e. non-linearities) being neglected; calculations are thus simplified.

535.343.4 **2347**

The Absorption Spectrum of Nitric Oxide in the Far Ultraviolet.—J. Granier & N. Astruc. (*C. R. Acad. Sci., Paris*, 12th March 1956, Vol. 242, No. 11, pp. 1431–1433.)

535.42 **2348**

On Asymptotic Series for Functions occurring in the Theory of Diffraction of Waves by Wedges.—F. Oberhettinger. (*J. Math. Phys.*, Jan. 1956, Vol. 34, No. 4, pp. 245–255.) An asymptotic expansion of the integral expression for diffraction by a wedge, at distances large compared with λ, is obtained as the sum of a Fresnel integral, as leading term, and an asymptotic series of inverse powers of the distance; for small values of the distance the expansion takes the form of a series involving Bessel functions.

537/538 **2349**

Multipotentials of Multipoles.—P. de Belatini. (*Bull. tech. Univ. Istanbul*, 1955, Vol. 8, pp. 57–74. In English.) General theory is presented, applicable equally to magnetic or dielectric multipoles. Every multipole is shown to be associated with a scalar or vector multipotential which has spherical symmetry; from the equation of this multipotential the usual scalar potential can be obtained by successive derivations.

537.21 **2350**

The Electrostatic Centre of a Conductor.—R. Cade & D. O. Vickers. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 175–179.)

537.221 : 537.533 **2351**

Variation of Volta Potential [work function] **with Temperature.**—G. C. Mönch. (*Z. Phys.*, 17th Jan. 1956, Vol. 144, Nos. 1–3, pp. 263–268.) Experimental results show that the measured work functions of Ag_2S, AgI and Cu_2O depend on the experimental conditions rather than on the electron concentration or structural phase changes. This was investigated in greater detail by Böttger (2352 below).

537.221 : 537.533 **2352**

Investigation of the Temperature Dependence of the Electron Work Function of Metals and Semiconductors.—O. Böttger. (*Z. Phys.*, 17th Jan. 1956, Vol. 144, Nos. 1–3, pp. 269–295.) The variation of the work function of copper and nickel sheets was determined from the I/V characteristics of a special diode with a tungsten filament, as a function of time, temperature (100° – 300°K) and degree of vacuum. The temperature dependence was also investigated for p-type Cu_2O, p-type NiO and n-type CuO. Results, presented graphically, indicate that for work-function measurements on metals a vacuum better than 10^{-5} Torr is required.

537.228.2 **2353**

On the Molecular Theory of Electrostriction.—B. K. P. Scaife. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 153–160.) The case of a sphere of fluid dielectric subjected to a uniform external field is discussed from both macroscopic and microscopic points of view. That part of the spur of the stress tensor $3\Delta P$ which depends quadratically on the applied field is calculated for both nonpolar and dipolar dielectrics; the Lorenz-Lorentz and Debye theories lead to the result that ΔP is zero, but more modern theories lead to a different result.

537.312.62 : 538.569.4 **2354**

Millimeter-Wave Absorption in Superconducting Aluminum.—M. A. Biondi, M. P. Garfunkel & A. O. McCoubrey. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1427–1429.) Available experimental evidence indicates that for wavelengths above ~ 1 cm the absorption is different for the normal and the superconducting states. Measurements are reported on a high-purity-Al waveguide; the ratio of surface resistivities for the superconducting and normal states is plotted as a function of temperature for various mm values of λ. The results are discussed in relation to alternative energy-gap models.

537.312.62 : 538.569.4 **2355**

Very-High-Frequency Absorption in Superconductors.—M. J. Buckingham. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1431–1432.) Measurements by Blevins et al. (1356 of May) indicate that the temperature at which the absorption departs from that in the normal state differs from the transition temperature T_0 by an amount strongly dependent on the frequency. A brief discussion shows that this dependence follows immediately from the concept of a gap in the electron-energy-level spectrum of a superconductor.

537.52 **2356**

Glow-to-Arc Transition.—W. S. Boyle & F. E. Haworth. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 935–938.) Conditions for the glow-to-arc transition at moderately high pressures (50–1 300 mm Hg) have been studied experimentally. Over this pressure range the transition is certain to occur only when the field reaches a critical value; this result is consistent with a field-emission mechanism for the transition.

537.525 **2357**

Theory of the High-Frequency Discharge in Gases at Low Pressures. Determination of Starting Conditions.—J. Salmon. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 33–36.) Continuation of work reported previously (2910 of 1955). The importance of secondary emission from the walls is emphasized. Experimental and theoretical curves of starting voltage as a function of pressure for frequencies of 25, 42·8 and 70·6 Mc/s are compared.

537.525.9.08 **2358**

Method of determining the Cathode Fall [of potential] **in a** [cold-cathode] **Glow Discharge.**—K. Rademacher & K. Wojaczek. (*Naturwissenschaften*, Feb. 1956, Vol. 43, No. 4, p. 78.) A brief account is given of a method involving the use of a hot-cathode discharge in one cross-arm of a cruciform tube with its positive column surrounding the cold cathode in the other arm.

537.533 **2359**

Experimental Verification of the Wave-Mechanical Theory of Field Electron Emission.—R. Haefer. (*Acta phys. austriaca*, Jan. 1956, Vol. 10, Nos. 1/2, pp. 149–161.) Methods described by Drechsler & Henkel (522 of 1955) are used to calculate the current density and field strength at a tungsten point and hence to estimate the accuracy of results obtained previously (1680 of 1941). Consideration is extended to the case when the tungsten is coated with foreign atoms.

537.533 : 621.38.032.212 **2360**

Electron Emission from Cold Metal Surfaces at Medium Field Strengths ($\sim 10^4$ V/cm).—K. Kerner. (*Z. angew. Phys.*, Jan. 1956, Vol. 8, No. 1, pp. 1–8.) Report and discussion of measurements of the field emission of Fe, Al and Ag cathodes. Ag gave the highest emission; Fe the lowest. See also 3193 of 1954 (Kerner & Raether).

537.56 **2361**

Dynamics of Ionized Media.—S. Gasiorowicz, M. Neuman & R. J. Riddell, Jr. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 922–934.) "The behavior of an ionized plasma is discussed in an approximation in which an individual particle is assumed to obey a Fokker-Planck equation, and where its interaction with the environment is incorporated in the coefficients of the partial differential equation."

538.221 **2362**

The Study of Ferromagnetism in the Institute of Physics at the University of Ferrara.—A. Drigo. (*Ricerca sci.*, Jan. 1956, Vol. 26, No. 1, pp. 138–143.) A short report outlining some of the more important results achieved. Both thin-film and massive specimens have been studied. Research on internal dissipation is being pursued.

538.3 **2363**

Electromagnetic Momentum and Electron Inertia in a Current Circuit.—E. G. Cullwick. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 159–170.) The magnetic energy of a current circuit is identified with the kinetic energy of the mass equivalent of the total e.m. energy of the conduction electrons. The concept of e.m. momentum in a current circuit is used to determine the force on the end wire of a long rectangular circuit and to bring the known effects of electron inertia in a circuit within the scope of e.m. theory.

538.561 : [537.533.9 + 537.591.8 **2364**

Radiation emitted by a Uniformly Moving Electron in Electron Plasma in a Magnetic Field.—A. A. Kolomenski. (*C. R. Acad. Sci. U.R.S.S.*, 21st Feb. 1956, Vol. 106, No. 6, pp. 982–985. In Russian.) Results of the theoretical considerations presented indicate that Čerenkov-type e.m. radiation may be produced by charged particles not necessarily moving at relativistic speeds, e.g. cosmic particles in the ionosphere. The frequencies of the radiated ordinary waves lie in the range $\omega < \omega_\theta$, where ω_θ is the plasma angular frequency, that of extraordinary waves in the range $\omega_\theta < \omega < \sqrt{\omega_\theta^2 + \omega_H^2}$ where ω_H is the gyrofrequency. Extraordinary waves only are produced (*a*) in weak magnetic fields and (*b*) by relativistic electrons.

538.566 : 535.13 **2365**

Investigation of the Propagation of [optical-type] **Signals in Dispersive Media, using an Acoustic Model.**—T. Ankel. (*Z. Phys.*, 17th Jan. 1956, Vol. 144, Nos. 1–3, pp. 120–131.) The theory of propagation of e.m. waves in a dispersive medium, as developed by Sommerfeld and Brillouin, is experimentally verified by measurements on an acoustic model which comprises a long hollow tube with closely spaced Helmholtz resonators along it.

538.566 : 535.42 **2366**

An Approximate Theory of the Diffraction of an Electromagnetic Wave by an Aperture in a Plane Screen.—R. F. Millar. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 177–185.) Theory based on the Sommerfeld half-plane solution is developed. For certain regions the field can be conceived as arising from the flow of electric and magnetic currents along the edge of the half-plane. This concept is extended to apertures of arbitrary form, the case of the circular aperture being studied particularly; the theory is supported by results of measurements.

621.3.013.78 : 538.221 **2367**

The Magnetic Screening Effect of Iron Tubes.—P. Hammond. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 112–120.) The problem is approached by considering the induced pole strength on the surface of the iron; the distribution of pole strength in general produces a magnetic field which varies from place to place over the screened region. Observations support the calculated values of screening ratio.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 : 551.5 **2368**

Radio Astronomy and the Fringe of the Atmosphere.—A. C. B. Lovell. (*Quart. J. R. met. Soc.*, Jan. 1956, Vol. 82, No. 351, pp. 1–14.) A survey presenting results of investigations on scintillations of radio stars in relation to the atmosphere in the 400-km altitude region, on meteor echoes, and on echoes from aurorae. The determination of the total electron content in the earth–moon space by the study of lunar echoes is discussed.

523.16 : 621.396.822 : 551.510.535 **2369**

Cosmic Radio-Frequency Radiation near One Megacycle.—G. Reber & G. R. Ellis. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 1–10.) Observations were made of cosmic radiation at 2·13, 1·435, 0·9 and 0·52 Mc/s during the period March–October 1955, at Hobart, Tasmania. Photographs of specimen records are reproduced. For values of the critical frequency near the observing frequency there is strong correlation between critical frequency and received amplitude; for lower values of critical frequency the received amplitude increases to an independent limiting value. The greatest intensity of the radiation arriving from the zenith when the plane of the galaxy was overhead was 10^{-19} W/m² per c/s per steradian at 2·13 Mc/s. (The name 'jansky' is suggested for the corresponding unit.) Only ordinary ionospheric propagation was important in the observations recorded.

523.78 : 538.56.029.6 **2370**

Observations of R.F. Emission from the Sun during the Solar Eclipse of 30th June 1954 at Byurakan [Armenian S.S.R.].—V. A. Sanamyan & G. A. Erznkanyan. (*Dokl. A. N. Arm. S.S.R.*, 1955, Vol. 20, No. 5, pp. 161–164. In Russian. *Referativnyi Zh., Fizika*, March 1956, No. 3, Abstract 8172.) Results, presented graphically, of intensity measurements during this partial eclipse (97% of total) show a decrease of up to 75% at 1·5 m λ and of up to 35% at 4·2 m λ. The diameter of the sun is 1·2 and 1·7 times the optical diameter at 1·5 m λ and 4·2 m λ, respectively.

550.38 : 523.165 **2371**

On Deriving Geomagnetic Dipole-Field Coordinates from Cosmic-Ray Observations.—J. A. Simpson, F. Jory & M. Pyka. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 11–22.) The coordinates of an equivalent dipole representing the external geomagnetic field can be determined from measurements of the nucleonic component longitude and latitude effects in the region of the geomagnetic equator. The measurement method and the relevant theory are outlined.

550.380.3 **2372**

Note on the Adjustment of Isomagnetic Charts to Mutual Consistency.—A. J. Zmuda. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 57–58.)

550.385 **2373**

Variations in Strength of Wind System, in the Dynamo Mechanism for the Magnetic Diurnal Variation, deduced from Solar-Flare Effects at Huancayo, Peru.—S. E. Forbush. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 93–105.)

551.510.41 : 523.78 **2374**

Electrophotometric Investigation of Atmospheric Ozone during the Solar Eclipses of 25th February 1952 and 30th June 1954.—Sh. A. Bezverkhni, A. L. Osherovich & S. F. Rodionov. (*C. R. Acad. Sci. U.R.S.S.*, 1st Feb. 1956, Vol. 106, No. 4, pp. 651–654. In Russian.)

551.510.52 : 621.396.11.029.62 **2375**

Abnormal V.H.F. Propagation.—Hooper. (See 2517.)

551.510.53 **2376**

Atmospheric Temperatures and Winds between 30 and 80 km.—W. G. Stroud, W. Nordberg & J. R. Walsh. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 45–56.) Rocket experiments made in New Mexico between July 1950 and September 1953 are described and the results are analysed. The mean altitude distribution

of temperature exhibits a maximum of about 270°K at 50 km, with a lapse rate of about 2·5°/km above the peak. The highest wind speed was observed during winter; its value was 104 m/s at 55 km.

551.510.53 **2377**

Arctic Upper-Atmosphere Pressure and Density Measurements with Rockets.—H. E. LaGow & J. Ainsworth. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 77–92.) Report of measurements made during 1953 and 1954 using rockets launched at an altitude of about 25 km from balloons; the greatest altitude reached was about 80 km. Results deviated in some cases from previous rocket measurements.

551.510.535 **2378**

Electron Distribution in the Ionosphere.—G. A. M. King. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 184–185.) Addendum to an earlier note (117 of 1955).

551.510.535 **2379**

Irregularity and Regularity of the Sporadic-E Layer.—K. Rawer. (*Geofis. pura appl.*, 1955, Vol. 32, No. 3, pp. 170–224. In German.) From observations at recording stations much information is obtained about the highest vertical-incidence reflection frequency fE_s, but less about the blanketing frequency f_bE_s. Results must be interpreted in statistical terms. Time- and distance-correlation functions are established. Diurnal, seasonal and geographic regularities are discussed. A sharp maximum in fE_s occurs at the magnetic equator. No well-defined influence of the solar cycle has been found and only a very weak lunar-tide effect. Observations of the variation of reflection coefficient with frequency have been made apart from the routine evaluations. In temperate latitudes in about a third of all cases there is no partial reflection; in other cases local variations of electron concentration are such that the peak-value/mean-value ratio is between 1 and 2; higher ratios are rare. At low latitudes the variation may be more important. Ionograms of different stations have been classified for transparency, scatter, angle of incidence and layer development. Diffuse echoes exist often near the magnetic equator. In most cases E_s ionization originates as a thin layer of constant altitude. Transitory downward movements are responsible for E_{2p} in daytime. A cumulo-cirrus cloud layer is a good model for E_s ionization. Possible ionization processes are discussed. About 50 references.

551.510.535 **2380**

Temperature Distribution under Control of Thermal Conductivity.—F. S. Johnson. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 71–76.) Bates' theory (988 of 1952) is extended. The energy absorbed in the F region is assumed to be conducted downward into a denser region where it is dissipated by infrared emission. Calculations indicate that the atmosphere is isothermal above about 250 km and that there is a very strong temperature gradient between 100 and 200 km. The temperature in the isothermal region must be assumed to be 1 100°K to meet the requirement for the atmosphere near 300 km to support an F_2 region. The low temperature at 80 km is due primarily to the lack of absorbed energy there rather than to the presence of a strongly emitting layer.

551.510.535 **2381**

A New Method for obtaining Electron-Density Profiles from *P'-f* Records.—J. E. Jackson. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 107–127.) "A practical and accurate method for reducing *P'-f* records to electron densities *vs* true height is described and used to analyse *P'-f* records taken at White Sands. Direct measurements of electron densities in the ionosphere obtained with the aid of rockets are used to check the method. Results obtained by these two independent techniques are shown to be in excellent agreement. Twenty *P'-f* records were reduced for the period from 1948 to 1954, all of which reveal a considerable degree of regularity in the height of the daytime E_1 and F_2 regions. Some of the profiles obtained are shown. One of the illustrations shows a one-hour sequence, where the F_2 virtual height varied from 650 km to 410 km, whereas the true height remained essentially unchanged."

551.510.535 **2382**

Airborne Ionospheric Measurements in the North Pole Area.—G. Gassmann. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 136–138.) A brief preliminary report.

551.510.535 : 523.78 : 621.396.11 **2383**

Ionospheric Observations at Banaras during the Total Solar Eclipse on 20th June 1955.—Banerjee, Surange & Sharma. (See 2514.)

551.510.535 : 621.3.082.7 **2384**

Polarization of the Echoes from the Ionosphere.—J. K. D. Verma & R. Roy. (*Indian J. Phys.*, Jan. 1956, Vol. 30, No. 1, pp. 36–46.) Details are given of an improved type of radio polarimeter, similar in principle to that evolved by Eckersley & Farmer (1968 of 1946), for operation in conjunction with high-resolution sounding equipment. With this arrangement it is possible to separate normal echoes from those received from thin E_s layers or cloud-type irregularities. Photographs of some observed polarization patterns are reproduced and briefly discussed.

551.510.535 : 621.396.812.3 **2385**

The Fading of Radio Waves of Frequencies between 16 and 2 400 kc/s.—Bowhill. (See 2519.)

551.510.535 : 621.396.812.3 **2386**

The Fading Periods of the E-Region Coupling Echo at 150 kc/s.—Parkinson. (See 2520.)

551.510.535 : 621.396.812.3 **2387**

The Determination of the Horizontal Velocity of Ionospheric Movements from Fading Records from Spaced Receivers.—D. W. G. Chappell & C. L. Henderson. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 163–168.) A method is presented which does not require a long sample of record and which is valid for any distribution of orientation of 'lines of maximum amplitude'. The derived formula is compared with that of Mitra (96 of 1950). See also 1418 of May (Court).

551.510.535 : 621.396.812.3 **2388**

A Determination of Ionospheric Winds for a 24-Hour Period.—G. W. G. Court & E. S. Gilfillan. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 169–170.) Results are given of an analysis, using the method proposed by Court (1418 of May), of the fading records obtained at spaced receivers during an arbitrarily chosen 24-h period. A diurnal variation of wind direction appears to be indicated.

551.594.1 **2389**

On the Deviations of the Course of Elements of Atmospheric Electricity on Continents from the Worldwide Course.—R. Mühleisen. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 146–157.) Extensive recordings show that continental deviations from the normal oceanic diurnal pattern of potential-gradient and

air-earth-current variations are caused mainly by positive space charges produced by urbanization, industry and traffic and distributed by air movements.

551.594.5 : 551.510.535 **2390**

Relationships between Aurora and Sporadic-E Echoes at Barrow, Alaska.—R. W. Knecht. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 59–69.) Report of observations of visual aurora made simultaneously with ionospheric soundings during March 1951; the observations for three nights are described in detail. Analysis of the results shows that E_s echoes at frequencies >7 Mc/s tend to occur when the aurora is near the zenith, that there is a direct relation between the brightness of inactive aurorae and the top frequency of E_s echoes, and that E_s echo ranges correspond with estimated slant ranges of visible auroral forms.

551.594.6 **2391**

The Annual Variations of the Atmospherics—Existence and Explanation of a Second Maximum in Winter, if Only Strong Impulses are Counted.—R. Reiter. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 23–26.) Records obtained at Munich of the numbers of atmospherics received in frequency ranges 10–50 kc/s and 4–12 kc/s over a period of five years are analysed and evaluated from the meteorological point of view.

551.594.6 **2392**

Stanford-Seattle Whistler Observations.—J. H. Crary, R. A. Helliwell & R. F. Chase. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 35–44.) Observations of times of occurrence of whistlers were made at Seattle, Washington, and Stanford, California, for two hours every week from October 1951 to October 1952, in order to determine the percentage of whistlers received simultaneously at both locations; the figure obtained was about 22%. This result is examined in relation to theories of whistler origin and propagation; it gives support to Storey's theory (142 of 1954). See also 1666 of 1955 (Koster & Storey).

551.594.6 : 551.510.535 **2393**

The 'Nose' Whistler—a New High-Latitude Phenomenon.—R. A. Helliwell, J. H. Crary, J. H. Pope & R. L. Smith. (*J. geophys. Res.*, March 1956, Vol. 61, No. 1, pp. 139–142.) Spectrograms of a type of whistler observed at College, Alaska, made by analysing tape recordings, are reproduced and discussed. The initial, or 'nose', frequency depends primarily on gyrofrequency, hence such observations should enable the effects of gyrofrequency and plasma frequency on dispersion to be separated, thus leading to more reliable estimates of the ionization density in the outer ionosphere.

551.594.6 : 551.510.535 **2394**

The Interpretation of Pulse Trains associated with Lightning Flashes.—W. O. Schumann. (*Z. angew. Phys.*, Jan. 1956, Vol. 8, No. 1, pp. 24–28.) A treatment of the propagation of atmospherics by earth and ionosphere reflections, assuming a radiating dipole source. See also 717 of 1955 (Hepburn & Pierce).

551.510.535 **2395**

Proceedings of the Fourth Meeting of the Mixed Commission on the Ionosphere. [Book Review]—Publishers: Union Radio-Scientifique Internationale, Brussels, 1954, 238 pp., 43s. (300 Belgian Fr. or $6.) (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, p. 83.) Contains papers presented in Brussels in August 1954, and discussions on them.

LOCATION AND AIDS TO NAVIGATION

621.396.933.1 **2396**

Beam Deflection Tube simplifies Radio Compass.—J. M. Tewksbury. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 166–167.) A design is described in which two miniature Type-6AR8 beam-deflection valves replace seven ordinary valves, thus reducing the size and weight of the equipment.

621.396.96 + 621.396.932 **2397**

Modernisation of Radio and Radar Equipment in H. M. Telegraph Ships.—W. Dolman & P. W. J. Gammon. (*P.O. elect. Engrs' J.*, Jan. 1956, Vol. 48, Part 4, pp. 204–207.)

621.396.96 **2398**

Radar P.P.I. Display uses Precision Interlace.—A. Shulman. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 168–171.) Target position data from automatic tracking computers are presented continuously in the form of marker dots on the p.p.i. screen by combining the two sets of scanning waveforms.

621.396.96 **2399**

Radar Polarization Power Scattering Matrix.—E. M. Kennaugh : C. D. Graves. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, p. 695.) Comment on 1425 of May and author's reply.

621.396.963.3 : 621.396.822 **2400**

Visual Detectability of Signals in Noise.—J. W. R. Griffiths. (*Wireless Engr*, May 1956, Vol. 33, No. 5, pp. 118–120.) The variation of output-signal/noise ratio as a function of 'contrast' (using this term in the sense of a bias) is investigated for different input-signal/noise ratios. The results agree qualitatively with experimental results on probability of detection in very simple systems.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.215 **2401**

Photoconductivity of Some Cyanine Dyes.—R. C. Nelson. (*J. opt. Soc. Amer.*, Jan. 1956, Vol. 46, No. 1, pp. 10–13.)

535.215 **2402**

Sensitization of Photoconductivity in Cadmium Sulfide [by cyanine dyes].—R. C. Nelson. (*J. opt. Soc. Amer.*, Jan. 1956, Vol. 46, No. 1, pp. 13–16.)

535.215 : 537.323 : 546.817.221 **2403**

Thermoelectric Force Measurements on Illuminated Lead Sulphide.—H. A. Müser. (*Z. Phys.*, 17th Jan. 1956, Vol. 144, Nos. 1–3, pp. 56–65.) Experiments indicate that the true thermoelectric force is not affected by illumination; apparent variations of thermoelectric force are due to photovoltaic effects.

535.215 : 546.482.21 **2404**

Photoelectromagnetic Effect in Insulating CdS.—H. S. Sommers, Jr, R. E. Berry & I. Sochard. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 987–988.) "The short-circuit photoelectromagnetic current in insulating crystals of cadmium sulfide has been measured in a batch of electroluminescent crystals. The product (mobility)^3 × (lifetime) is found to be 1 cm^6/volt^{3}sec^2. The sensitivity of the equipment is sufficient to detect the photoelectromagnetic effect for crystals whose product is as low as 10^{-3} cm^6/volt^{3}sec^2."

535.37 **2405**

Associated Donor-Acceptor Luminescent Centers.—J. S. Prener & F. E. Williams. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, p. 1427.) Brief discussion of the properties of (Zn, Cd) (S, Se) phosphors activated with Cu, Ag, Au, P, As or Sb and co-activated with Cl, Br, I, Al, Ga or In.

535.37 : 535.215 **2406**

Dielectric Changes in Inorganic Phosphors.—S. Kronenberg & C. A. Accardo. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 989–992.) ZnS-CdS phosphors were investigated by using them as dielectrics in capacitors and exposing them to light. Observed capacitance changes are attributed partly to photoconduction effects and partly to true variations of dielectric constant.

535.37 : 535.215 : 546.472.21 **2407**

Determination of the Ratio of Effective Cross-Sections of Capture and Recombination of Optical {photo-liberated} **Electrons in ZnS-Cu,Co Crystal Phosphors.**—Syuĭ Syuĭ-Yun. (*C. R. Acad. Sci. U.R.S.S.*, 11th Feb. 1956, Vol. 106, No. 5, pp. 818–821. In Russian.)

535.37 : 546.48.185.161 **2408**

Lead- and Manganese-Activated Cadmium Fluorophosphate Phosphors.—R. W. Wollentin. (*J. electrochem. Soc.*, Jan. 1956, Vol. 103, No. 1, pp. 17–23.)

535.376 **2409**

Influence of Temperature on the Electroluminescence of Zinc Sulphides.—J. Mattler. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 42–51.) An extended account of the investigation described previously (1362 of 1955).

535.376 : 546.472.21 **2410**

Time-Average Electroluminescence Output of some Zinc Sulfide Phosphors.—S. Nudelman & F. Matossi. (*J. electrochem. Soc.*, Jan. 1956, Vol. 103, No. 1, pp. 34–38.) "Dependence of time-average electroluminescence output on field strength and frequency is observed for frequencies up to 20 kc/s for green and blue emission. The field dependence can be described either by a power law or by an exponential law. The frequency dependence is discussed in terms of theoretical relations connecting the light output to recombination characteristics or to polarization effects. The polarization effects are of minor importance. Light outputs from sinusoidal and square wave excitation are compared."

535.376 : 546.472.21 : 537.226.2 **2411**

Dielectric Behavior of Electroluminescent Zinc Sulfides.—W. Lehmann. (*J. electrochem. Soc.*, Jan. 1956, Vol. 103, No. 1, pp. 24–29.) Measurements were made at voltages up to 600 V r.m.s. and frequencies up to >20 kc/s; the measurement cell and technique are discussed. Both the real and the imaginary parts of the dielectric constant vary inversely with frequency. The results support previous assumptions that the excitation mechanism for electroluminescence is different from that for photoluminescence, while the emission mechanisms are similar.

537.226/.227 **2412**

Behaviour of Ferroelectric $KNbO_3$ in the Vicinity of the Cubic-Tetragonal Transition.—S. Triebwasser. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 993–997.) Measurements on $KNbO_3$ single crystals are reported. From the values found for dielectric constant and spontaneous polarization a determination can be made of the first three terms of the power series expressing the free energy in terms of the polarization. The behaviour of the crystals in the cubic and tetragonal phases is in reasonable agreement with predictions based on Devonshire's theory for $BaTiO_3$ (663 of 1950 and 1341 of 1952); the corresponding constants for the two materials are of the same order of magnitude.

537.226/.227 : 546.431.824-31 **2413**

A Microstructure Study of Barium Titanate Ceramics.—F. Kulcsar. (*J. Amer. ceram. Soc.*, 1st Jan. 1956, Vol. 39, No. 1, pp. 13–17.) Polishing and etching techniques for preparing polycrystalline $BaTiO_3$ for metallographic examination are described. Photomicrographs are reproduced and discussed. A companion paper by Cook (*ibid.*, pp. 17–19) analyses some of the domain patterns found.

537.226/.227 : 546.431.824-31 **2414**

A Modified Replica Technique and its Application to the Examination of Etched Single Crystals of Barium Titanate.—D. S. Campbell & D. J. Stirland. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, pp. 62–65.)

537.227 **2415**

Properties of Guanidine Aluminum Sulfate Hexahydrate and Some of its Isomorphs.—A. N. Holden, W. J. Mertz, J. P. Remeika & B. T. Matthias. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 962–966.) Report of an experimental study of this new class of ferroelectrics (2987 of 1955). The crystals are trigonal, with the ferroelectric direction along the trigonal axis. The 60-c/s hysteresis loops are often biased or double, the shape being correlated with the location of the specimen in the mother crystal. At room temperature the saturation polarization is about 0·35 $\mu C/cm^2$ and the coercive force at 60 c/s is 1–3 kV/cm; these quantities increase with falling temperature. The small-signal dielectric constant is about 6 along the axis and about 5 perpendicular to it. The switching characteristics resemble those of $BaTiO_3$, but the present crystals are considerably slower.

537.228.1 : 548.5 **2416**

The Laboratory Production of Large Water-Soluble Crystals.—E. A. Taylor. (*P.O. elect. Engrs' J.*, Jan. 1956, Vol. 48, Part 4, pp. 219–223.) The production of synthetic crystals having useful piezoelectric properties is described.

537.311.3 **2417**

The Conductivity of an Antimony-Caesium Layer.—L. I. Shafratova-Ekertova. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1357–1363.) If an Sb-Cs layer is in contact with two metallic electrodes and a constant potential difference is applied to the electrodes, the current through the layer increases with time. A report is presented on an experimental investigation into the physical nature of this phenomenon; the results obtained are interpreted theoretically. It is suggested that the phenomenon is due to polarization of the layer in a sense facilitating the passage of current.

537.311.3 : 539.23 **2418**

On the Measurement of Electric Constants of Thin Metallic Films.—G. Bonfiglioli, E. Coen & R. Malvano. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 201–203.) For thin films, whose detailed geometrical form is usually unknown, it is impossible to determine the Hall coefficient and conductivity separately, but their product—the Hall mobility of the carriers—can be determined. Measurements on Au films evaporated on to mica bases are reported; the mobility is independent of film thickness between 100 and 600 Å, but its value is only about a quarter of the bulk mobility. The structure of thin films is discussed in the light of this result.

537.311.3 : 546.841.4-31 **2419**

Polarization in Thorium Oxide Crystals.—W. E. Danforth & J. H. Bodine. (*J. Franklin Inst.*, Dec. 1955, Vol. 260, No. 6, pp. 467–483.) Description and discussion of phenomena observed when a constant current is passed through a thoria crystal in vacuum at temperatures between 900° and 1 300°C. Resistivity varied from 6 000 to 400Ω.cm over this temperature range. Conduction seems to be almost entirely ionic, the electron current being <1% of the total.

537.311.31 + 537.311.33 **2420**

On the Transport Properties of Metals and Semiconductors.—D. Ter Haar. (*Physica*, Jan. 1956, Vol. 22, No. 1, pp. 61–68.) Simple kinetic theory is used to derive approximate expressions for the thermal conductivity, electrical conductivity, thermoelectric power, Hall constant and magnetoresistance of metals and semiconductors.

537.311.31 **2421**

Modulation of Conductivity by Surface Charges in Metals.—G. Bonfiglioli, E. Coen & R. Malvano. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1281–1284.) Measurements were made on thin films of Au, Bi and Sb; a large surface charge was induced by application of an electric field. A tentative interpretation of the observed conductivity changes is offered. See also 2418 above.

537.311.32 + 536.21] : 546.26 **2422**

The Thermal and Electrical Conductivities of Deposited Carbon.—A. R. G. Brown, W. Watt, R. W. Powell & R. P. Tye. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, pp. 73–76.) Measurements were made in the temperature range 20°–200°C on commercial graphite and deposited carbon formed at 1 800°, 1 900°, 2 000° and 2 100°C. The thermal conductivities of the specimens deposited at 2 000° and 2 100°C were respectively 20% and 40% greater than that of copper. The electrical resistivity at 20°C was about $24{\cdot}5 \times 10^{-5}$Ω.cm for carbon deposited at 2 100°C compared with $76{\cdot}2 \times 10^{-5}$ for commercial graphite or 323×10^{-5} for carbon deposited at 1 800°C. The results are tabulated.

537.311.33 **2423**

Transport and Deformation-Potential Theory for Many-Valley Semiconductors with Anisotropic Scattering.—C. Herring & E. Vogt. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 944–961.) A theory of transport phenomena is presented based on assumptions regarding the scattering processes which are less restrictive than those made previously [e.g. 2642 of 1955 (Herring)]. Three relaxation times are assumed, corresponding to the three principal directions of the ellipsoidal energy surfaces. Expressions for carrier mobility, Hall effect, magnetoresistance, piezoresistance and h.f. dielectric constant are derived in terms of the relaxation-time tensor. The deformation-potential approach of Bardeen & Shockley (3032 of 1950) is generalized to suit the many-valley model. The results are used for correlating mobility, piezoresistance, etc. for *n*-type Si and Ge.

537.311.33 **2424**

Effects of Pressure on the Electrical Properties of Semiconductors.—D. Long. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1256–1263.) Continuing previous work (e.g. 161 of January), various measurements have been made on Ge, InSb, InAs, GaSb, Te and Mg_2Sn at pressures up to 2 000 atm. The results are used to deduce the pressure dependence of carrier concentration, mobility, energy gap and effective mass. Whereas in Ge and Mg_2Sn the energy gap increases with increased pressure, in Te it decreases.

537.311.33 **2425**

Simultaneous Transport of Heavy and Light Holes in Semiconductors with a Degenerate Valence Band.—E. S. Rittner. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1291–1294.) "A theoretical study is presented of the motion in an *n*-type semiconducting filament of an injected narrow pulse of slow and fast holes subject to drift, diffusion, recombination, and reversible interband transitions. For low injection level and for interband transition times which are small compared to the recombination lifetime and to the observation time but large compared to the time between collisions, it is shown that both sets of holes propagate and broaden as a single pulse with a group mobility and diffusivity heavily weighted by that of the slower holes. This explains why only a single pulse is observed at the collector in drift mobility experiments."

537.311.33 **2426**

Degeneracy of the Electron Gas in Semiconductors.—A. G. Samoilovich & L. L. Korenblit. (*Uspekhi fiz. Nauk*, Dec. 1955, Vol. 57, No. 4, pp. 577–630.) A survey of work on factors affecting and effects of the electron-gas degeneracy. 42 references, about half of which are to Russian literature.

537.311.33 **2427**

A Formula for the Voltage/Current Characteristic of an *n-p* Junction.—V. L. Bonch-Bruevich & E. Ya. Pumper. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1520–1521.) If formula (1) proposed by Shockley (*Theory of Electronic Semiconductors*, 1953) is correct, then the ratio of the forward and reverse currents, for the same absoiute value of the applied voltage, should be independent of the nature of the semiconductor. Such a general conclusion does not seem to be justifiable, hence the accuracy of the formula is questionable.

537.311.33 : 535.215 **2428**

Photoelectric Phenomena with Copper Phthalocyanine.—H. Baba, H. Chitoku & K. Nitta. (*Nature, Lond.*, 7th April 1956, Vol. 177, No. 4510, p. 672.) Experiments are briefly reported, the results of which indicate that this material is a semiconductor exhibiting photoconductive and photovoltaic properties.

537.311.33 : 535.215 : 546.682.86 **2429**

Photoconductive and Photoelectromagnetic Effects in InSb.—S. W. Kurnick & R. N. Zitter. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 278–285.) Measurements on single-crystal plates of *p*-type InSb were made at temperatures of 77° and 301°K. Electropolished and mechanically polished specimens yielded very different results. A simple two-dimensional theoretical model is used to interpret the results; it is assumed that hole-electron pairs are produced by the illumination at the surface only.

537.311.33 : 537.32 : 621.362 **2430**

Increasing the Efficiency of Semiconductor Thermocouples.—A. F. Ioffe, S. V. Airapetyants, A. V. Ioffe, N. V. Kolomoets & L. S. Stil'bans. (*C. R. Acad. Sci. U.R.S.S.*, 21st Feb. 1956, Vol. 106, No. 6, p. 981. In Russian.) Results of theoretical considerations indicate that for maximum efficiency a high ratio of charge-carrier mobility to thermal conductivity is desirable. This can be achieved by using an isomorphous impurity to decrease the thermal conductivity; the charge-carrier mobility remains practically unchanged. The maximum efficiency occurs, theoretically, when the thermal e.m.f. of each branch of the thermocouple is about $\pm 200\,\mu$V/degree.

537.311.33 : 546.23 **2431**

Influence of Light on the Dipole Absorption of E.M. Radiation by Selenium.—Y. Meinnel, J. Meinnel & Y. Balcou. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 78–79.) Experiments with powder specimens of Se show that the activation energy is considerably lower for the illuminated than for the unilluminated material.

537.311.33 : [546.28 + 546.289 **2432**

Electrolytic Shaping of Germanium and Silicon.—A. Uhlir, Jr. (*Bell Syst. tech. J.*, March 1956, Vol. 35, No. 2, pp. 333–347.) Barrier effects and other phenomena occurring in the electrolytic etching of semiconductors, especially Ge, are described and techniques for using them in the shaping of semiconductor devices are discussed. Auxiliary techniques for localizing the action include optical illumination. Suitable electrolytes for etching Ge and Si are indicated.

537.311.33 : [546.28 + 546.289 **2433**

Infrared Absorption and Oxygen Content in Silicon and Germanium.—W. Kaiser, P. H. Keck, & C. F. Lange. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1264–1268.) "An optical absorption band at 9 μ has been correlated with the oxygen content in silicon. Pulled silicon crystals were found to contain up to 10^{18} oxygen atoms per cm^3 which seem to originate from the quartz crucible. The oxygen concentration in silicon crystals prepared by the floating zone technique in vacuum was found to be less than 10^{16} oxygen atoms per cm^3. The 9 μ absorption due to silicon-oxygen bond stretching vibrations provides a possibility for a quantitative oxygen analysis of high sensitivity. A corresponding absorption in germanium at 11·6 μ is believed to be due to a germanium-oxygen vibration."

537.311.33 : [546.28 + 546.289 **2434**

Surface States on Silicon and Germanium Surfaces.—H. Statz, G. A. deMars, L. Davis, Jr, & A. Adams, Jr. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1272–1281.) Measurements of the conductivity of *p*-type inversion layers on *n*-type crystals are reported and discussed. The steady-state conductance is related to a high density of surface states outside the oxide film which forms on the surface, while the non-steady-state conductance is related to states located at the semiconductor/oxide interface; the energy levels of the latter states are 0·455 and 0·138 eV below the middle of the energy gap for Si and Ge respectively. The mechanism of charge transfer through the oxide film is not yet clear.

537.311.33 : [546.28 + 546.289 **2435**

Effect of Dislocations on the Minority Carrier Lifetime in Semiconductors.—A. D. Kurtz, S. A. Kulin & B. L. Averbach. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1285–1291.) "The density of random dislocations in germanium and silicon crystals has been measured by means of X-ray rocking curves and by etch pit counting. Data obtained by the two methods are in good agreement, and dislocation densities in the range 10^4–$10^7/cm^2$ were found. The minority carrier lifetime was shown to vary with the dislocation density, and the results could be expressed in terms of a recombination efficiency per unit length of dislocation line, $\sigma_R = 1/N_D\tau$ (where N_D = dislocation density, τ = lifetime). σ_R was found to decrease with increasing resistivity of germanium and was higher for silicon than for germanium of comparable purity."

537.311 33 : [546.28 + 546.289 **2436**

Ionization by Collision in Silicon and Germanium.—E. Groschwitz. (*Z. Phys.*, 10th Jan. 1956, Vol. 143, No. 5, pp. 632–636.) The ionization coefficient α of an electronic semiconductor is calculated as a function of the electric field strength. Comparison with experimental results [1079 of 1954 (McKay & McAfee)] indicates that ionization by collision is determined by the interaction of the conduction electrons with acoustic as well as optical energy quanta.

537.311.33 : [546.28 + 546.289] : 621.311.6 **2437**

The Electron-Voltaic Effect in Germanium and Silicon *P-N* Junctions.—P. Rappaport, J. J. Loferski & E. G. Linder. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 100–128.) Extension of the investigation reported previously [1799 of 1954 (Rappaport)] of the voltage produced across the junction as a result of β-particle bombardment. Measurements on large-area alloy junctions are reported. The maximum efficiency of conversion of the radioactive power is probably $\gtrsim$ 5% for Si; measured values of 2·5% were obtained. The life of the devices may be limited by the damage due to the high-energy bombardment.

537.311.33 : 546.28 **2438**

Photographs of the Stress Field around Edge Dislocations.—W. L. Bond & J. Andrus. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, p. 1211.) Infrared photographs obtained with Si crystals are reproduced.

537.311.33 : 546.28 : 621.314.7 **2439**

Surface Treatment of Silicon for Low Recombination Velocity.—A. R. Moore & H. Nelson. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 5–12.) Surface recombination velocities comparable with those for Ge can be obtained for *p*-type Si by treating the surface chemically so as to produce films of aniline-like aromatic liquids or of salts of sodium-dichromate type. Some details are given of the techniques involved and of the resulting improvement in the current amplification factor of *n-p-n* transistors. The treatment also eliminates channelling leakage at junctions. This is consistent with the theory that the films cause the energy bands to curve upwards at the surface.

537.311.33 : 546.289 **2440**

Effects of the Dislocations on Minority Carrier Lifetime in Germanium.—J. Okada. (*J. phys. Soc. Japan*, Dec. 1955, Vol. 10, No. 12, pp. 1110–1111.) A quantitative study is made, based on measurements of dislocation density, recombination velocity and carrier lifetime; the results are compared with theoretically deduced relations between these quantities. The density of active recombination centres along a dislocation is deduced to be about 6×10^8/cm.

537.311.33 : 546.289 **2441**

Effect of Electric Field on Surface Recombination Velocity in Germanium.—J. E. Thomas, Jr, & R. H. Rediker. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 984–987.) Experiments are described confirming theoretical predictions of correlation between surface recombination velocity and surface potential for *n*-type Ge. The results also give support to explanations of semiconductor excess noise based on the assumption of surface traps. The influence of the ambient atmosphere is studied.

537.311.33 : 546.289 **2442**

Relaxation Effects in Recombination Velocity on Germanium Surfaces under Transverse Electrostatic Fields.—A. Many, Y. Margoninski, E. Harnik & E. Alexander. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1433–1434.) Relaxation effects in surface recombination velocity were observed using the experimental technique described by Henisch & Reynolds (3652 of 1955). An explanation given previously in connection with surface conductivity [e.g. 3649 of 1955

(Kingston)] is applicable in this case also. The experimental results are correlated with corresponding data on surface conductivity in a separate paper (*ibid.*, pp. 1434–1435).

537.311.33 : 546.289 **2443**

Delay Time of Plastic Flow in Germanium.—J. R. Patel. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1436–1437.) Some experimental results are reported and discussed.

537.311.33 : 546.289 **2444**

Simple Method of Revealing *p-n* Junctions in Germanium.—R. W. Jackson. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 309–310.) Details are given of an electrolytic etching method in which the Ge slice has a silver electrode painted on one side and the electrolyte is prevented from wetting this side.

537.311.33 : 546.289 : 621.396.822 **2445**

Excess Noise Spectra in Germanium.—F. J. Hyde. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 242–245.) Spectral distributions are investigated in which the noise varies as f^{-m} over a wide range of frequencies, where m is not equal to unity. A diagram shows the spectrum for an *n*-type Ge filament, synthesized from two f^{-1} arc cot $(\omega\tau)$ spectra with limiting relaxation times τ_1 and τ_2 of 2×10^{-4} and 5×10^{-7} sec respectively. By superposing two basic spectra of this type, such as are postulated to arise from two recombination-centre levels, it is possible to generate an exponent which is practically constant at 1·24 over three decades of frequency. See also 2558 below.

537.311.33 : 546.561-31 **2446**

Lattice Defects and Dipole Absorption of E.M. Radiation by Cuprous Oxide.—J. Meinnel, E. Daniel & Y. Colin. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 79–80.) Experiments have been made on a number of samples at temperatures from 77° to 350°K and at frequencies from 50 c/s to 28 Mc/s. Strong dipole absorption bands were observed in all cases. Activation energies between 0·18 and 0·44 eV are deduced.

2447

537.311.33 + 538.22] : [546.823.171 + 546.823.261] : 539.23

Some Electrical Properties of Titanium Nitride and Titanium Carbide.—A. Münster & K. Sagel. (*Z. Phys.*, 17th Jan. 1956, Vol. 144, Nos. 1–3, pp. 139–151.) Full report of experiments noted in 1386 of 1955 (Münster et al.). The semiconductor properties observed in TiN and TiC films deposited on SiO_2 may be due to inclusion of oxygen atoms.

537.311.33 : 546.863.683.231 **2448**

Electron Diffraction Determination of the Structure of $Tl_2Sb_2Se_4$.—Z. G. Pinsker, S. A. Semiletov & E. N. Belova. (*C. R. Acad. Sci. U.R.S.S.*, 21st Feb. 1956, Vol. 106, No. 6, pp. 1003–1006. In Russian.)

537.311.33 : 546.873.241 : 536.21 **2449**

The Thermal Conductivity of Bismuth Telluride.—H. J. Goldsmid. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 203–209.) Measurements over the temperature range 150°–300°K indicate that the electronic contribution to the heat conduction is considerably greater for specimens in which the charge carriers are intrinsically excited than for specimens in which most of the carriers arise from an impurity concentration. This result can be explained by a theory which takes into account the transfer of ionization energy down a temperature gradient.

538.22 : 546.3-1-71-59 **2450**

Ferromagnetic and Antiferromagnetic Properties of the System Gold-Manganese.—A. Kussmann & E. Raub. (*Z. Metallkde*, Jan. 1956, Vol. 47, No. 1, pp. 9–15.) Experiments have established the existence of the ferromagnetic phase Au_4Mn. The phase Au_2Mn exhibits ferromagnetism and antiferromagnetism. The phase AuMn may also be antiferromagnetic.

538.221 **2451**

Intradomain Magnetic Saturation and Magnetic Structure of γ-Fe_2O_3.—W. E. Henry & M. J. Boehm. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1253–1254.) "The average moment for γ-Fe_2O_3 was found to be 1·18 Bohr magnetons per iron atom, which supports a preferential distribution of iron vacancies on octahedral sites in a spinel structure. A sample motion ballistic method was used for direct measurement of magnetic moments."

538.221 **2452**

Ferromagnetic Domain Nucleation in Silicon Iron.—L. F. Bates & D. H. Martin. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 145–152.) "Powder deposit patterns obtained by the authors on single crystals of 3% silicon iron are consistent with a description of the processes of domain phase creation in terms of nucleation at inclusions in the surfaces. Domain nucleation is discussed in relation to various magnetic properties."

538.221 **2453**

Variation of the Magnetic Anisotropy Energy of Ni and of Ni-Cu Alloys as a Function of Temperature.—M. Sato & Y. Tino. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 5–8.) Theory is based on consideration of the magnetic interactions between atoms in a crystal lattice. The anisotropy constant can be expressed as an exponential function of the square of the absolute temperature.

538.221 : 537.311.33 **2454**

Induced Ferromagnetism demonstrated by Addition of Lithium Ions to Nickel Oxide.—N. Perakis, A. Serres, G. Parravano & J. Wucher. (*C. R. Acad. Sci., Paris*, 5th March 1956, Vol. 242, No. 10, pp. 1275–1277.)

538.221 : 538.569.4 **2455**

Resonance of Ferrites at the Compensation Point in a Circularly Polarized Field (Ferrimagnetic Resonance).—J. Paulevé & B. Dreyfus. (*C. R. Acad. Sci.*, Paris, 5th March 1956, Vol. 242, No. 10, pp. 1273–1275.) Measurements on ferrites of composition $Li_{0.5}Fe^{3+}_{2.5-a}\,Cr^{3+}_{a}O_4$ in a circularly polarized u.h.f. field indicate that two types of resonance line can be distinguished in the neighbourhood of the compensation temperature; the gyromagnetic ratio corresponding to one of these is of sign opposite to that of the electron.

538.221 : 621.318.1 **2456**

Ferromagnetism in Relation to Engineering Magnetic Materials.—F. Brailsford. (*Proc. Instn elect. Engrs*, Part A, Feb. 1956, Vol. 103, No. 7, pp. 39–51.) " . . . a review is given of theoretical and experimental work mainly within the past ten years. This includes an account of ferromagnetic domains and of the small-particle theory of high coercivity. A description of the ferrites and of ferrimagnetism is given, and this is followed by a discussion of recent observations and ideas on the magnetic phenomena occurring at frequencies up into the microwave region."

538.632 **2457**

Significance of Hall-Effect Measurements on Alloys.—B. R. Coles. (*Phys. Rev.*, 15th Feb. 1956, Vol. 101, No. 4, pp. 1254–1255.) Hall-effect data for a number of alloys are examined in the light of the accepted theory of this effect. It is concluded that assumptions made about the relaxation time which seem appropriate when scattering by lattice vibrations predominates are not valid when scattering by solute atoms becomes significant.

539.234 **2458**

Influence of the Thickness of Thin [evaporated] **Films on their Structure: Case of the Alloy Cu-Be.**—A. Viswanathan. (*C. R. Acad. Sci., Paris*, 19th March 1956, Vol. 242, No. 12, pp. 1586–1587.)

548.0 : [546.47 + 546.289 **2459**

Investigations of Texture in Thin Zinc and Germanium Films.—A. Segmüller. (*Z. Kristallogr.*, Jan. 1956, Vol. 107, Nos. 1/2, pp. 18–34.) An electron-optical crystallographic investigation at temperatures between 90° and 770°K is reported. Good single-crystal texture may be obtained at relatively low temperatures by depositing the Zn or Ge on a zinc-blende cleavage plane.

548.0 : 549.514.51 **2460**

Laws of Intergrowth of Oriented Rutile Inclusions in Quartz.—J. von Vultée. (*Z. Kristallogr.*, Jan. 1956, Vol. 107, Nos. 1/2, pp. 1–17.)

621.3.066.6 : 537.311.4 **2461**

Contact Resistance and Surface of Contact.—K. Millian & W. Rieder. (*Z. angew. Phys.*, Jan. 1956, Vol. 8, No. 1, pp. 28–34.) An investigation of the influence of contact pressure, aging and surface treatment, including greasing, on the contact resistance of crossed cylinders of Cu, Ag and W. For Cu and for heat-treated W the contact resistance increases exponentially with time.

621.315.612 **2462**

Boron Nitride.—K. M. Taylor. (*Mater. & Meth.*, Jan. 1956, Vol. 43, No. 1, pp. 88–90.) Physical properties of this ceramic insulating material are indicated.

621.315.615 : 537.52 **2463**

Breakdown Field Strength in Dielectric Liquids with Different Molecular Structure.—E. Musset, A. Nikuradse & R. Ulbrich. (*Z. angew. Phys.*, Jan. 1956, Vol. 8, No. 1, pp. 8–15.) Report of measurements made on some 30 organic liquids at atmospheric pressure, using d.c. and 50-c/s a.c.

621.315.616 : 537.533.9 **2464**

Electrons produce High-Temperature Dielectric.—J. B. Meikle & B. Graham. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 146–149.) A modified polyethylene irradiated by high-energy electrons has a volume resistivity of $10^{19}\Omega$.cm, dielectric constant of 2·3 and power factor <0·0007, while retaining the other physical properties of normal polyethylene; the new material is stable up to 300°C. Technique involved in the use of the electron accelerator in the processing of cable insulation etc. is outlined.

MATHEMATICS

517 : 519.241.1 **2465**

A Short Table of the Laguerre Polynomials.—L. J. Slater. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 46–50.) A function referred to in connection with correlation analysis [2352 of 1955 Lampard)] is tabulated.

517.5 **2466**

The Method of Stationary Phase.—G. Braun. (*Acta phys. austriaca*, Jan. 1956, Vol. 10, Nos. 1/2, pp. 8–33.) The method presented is useful for evaluating an integral encountered in diffraction theory.

517.5 **2467**

On the Error Function of a Complex Argument.—J. Kestin & L. N. Persen. (*Z. angew. Math. Phys.*, 25th Jan. 1956, Vol. 7, No. 1, pp. 33–40. In English.) A simplified method of dealing with the error function is presented, based on a transformation. Both the real and the imaginary components can be split into two parts, of which the first can be expressed by elementary functions while the second can be represented by two integrals which can be easily evaluated.

517.9 **2468**

Integration of a Nonlinear Integral Equation.—P. Lévy. (*C. R. Acad. Sci., Paris*, 5th March 1956, Vol. 242, No. 10, pp. 1252–1255.) The equation discussed is that relating the kernel and the covariance of a random Laplace function $\Phi(t)$.

519.281.2 **2469**

Two Methods of obtaining Least-Squares Lines.—I. H. Sher. (*Science*, 20th Jan. 1956, Vol. 123, No. 3186, pp. 102–104.)

518.2 **2470**

Index Mathematischer Tafelwerke und Tabellen aus allen Gebieten der Naturwissenschaften. [Book Review]—K. Schütte. Publishers: R. Oldenbourg, Munich, 1955, 143 pp., 14.50 D.M. (*Nature, Lond.*, 28th April 1956, Vol. 177, No. 4513, p. 767.)

MEASUREMENTS AND TEST GEAR

529.7 **2471**

Atomic and Astronomical Time.—L. Essen & J. V. L. Parry. (*Nature, Lond.*, 21st April 1956, Vol. 177, No. 4512, pp. 744–745.) The National Physical Laboratory quartz clock has been calibrated at regular intervals by reference to the Cs resonator (3686 of 1955). A curve shows the frequency deviation over the period from June 1955 to January 1956, and a second curve shows the deviation from the Greenwich monthly revised values. The difference between these two curves represents the variation of the unit of astronomical time in terms of the Cs standard. Further curves show the Greenwich values reassessed after a long period, and astronomical observations, both in terms of the Cs standard.

621.3.001.3(083.74) : 621.318.423 **2472**

The Effect of Humidity on the Stability of Inductance Standards.—G. H. Rayner & L. H. Ford. (*J. sci. Instrum.*, Feb. 1956, Vol. 33, No. 2, pp. 75–77.) The changes in inductance of the National Physical Laboratory substandard inductance coils for a 10% increase in relative humidity range from +0·7 part in 10^4 on a 100-μH coil to −0·25 part in 10^4 on a 10 000-μH coil. The changes may be partly explained by dimensional changes in the formers of the coils.

621.317.3 : 621.396.822 **2473**

Fluctuations in a Loaded Line.—V. S. Troitski. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1426–1435.) In measuring noise in a dipole connected to the noise meter by a long line, conditions may be created under

which the intrinsic noise of the meter input is reflected from the dipole, and thus the signal to be measured is changed by an unknown quantity. Conditions necessary for the measurement of weak noise are discussed, sources of errors are indicated, and methods for their elimination are proposed.

621.317.3 : [621.396.96 + 621.397.5 **2474**

Video Measurements employing Transient Techniques.—H. A. Samulon. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 638–649.) Equipment and waveforms suitable for testing television, radar and other systems are reviewed, and methods of measurement and evaluation of the response characteristics are discussed. The effect on the transient response of small variations in the transfer function of the system is examined. Criteria for assessing transient response are listed.

621.317.3(083.74) : 621.372.029.3 **2475**

I.R.E. Standards on Audio Systems and Components: Methods of Measurement of Gain, Amplification, Loss, Attenuation, and Amplitude-Frequency-Response, 1956.—(*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 668–686.) Standard 56 I.R.E.3.S1.

621.317.33.084.2 : 537.311.33 **2476**

A Four-Point Probe Apparatus for measuring Resistivity.—D. B. Gasson. (*J. sci. Instrum.*, Feb. 1956, Vol. 33, No. 2, p. 85.) Description of apparatus with probe spacing of 1 mm and minimum surface leakage path of 1 cm which has been developed for measuring resistivities of semiconductors.

621.317.335.3 **2477**

Line Corrections in Permittivity Measurements at Frequencies below 50 Mc/s.—R. Guillien. (*J. Phys. Radium*, Jan. 1956, Vol. 17, No. 1, pp. 52–56.) Classical line theory is used to determine the corrections necessary to take account of the line joining the specimen to the measuring apparatus in measurements at Mc/s frequencies. Formulae are derived giving ϵ' and ϵ'' directly in terms of the measured value of the apparent dielectric constant.

621.317.335.3.029.64 **2478**

A Centimetre-Wave Parallel-Plate Spectrometer.—P. H. Sollom & J. Brown. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 419–428.) The instrument described is based on the same general principles as that of Culshaw (1135 of 1954), but the radiation is enclosed between two parallel disks of diameter about 4 ft whose spacing, which is equal to the height of the specimen, is only 3/16 in. The radiation is injected by means of a sectoral horn free to move over a 90° sector of the disk circumference, and is detected by a similar horn or a waveguide located anywhere on the circumference.

621.317.337 : 621.372.412 : 537.228.1 **2479**

A New Method for measuring the Quality Factor Q of Piezoelectric Crystals.—H. Mayer. (*C. R. Acad. Sci., Paris*, 12th March 1956, Vol. 242, No. 11, pp. 1428–1430.) H.f. oscillations exciting the crystal at its resonance frequency are interrupted by means of a vibrator at 100 c/s. During the interruptions the crystal executes damped oscillations; these are displayed on a c.r.o. and the Q factor hence determined. For glucinium sulphate the Q value obtained is 6 700 in vacuum, 3 300 in air.

621.317.34 : 621.317.729 : 621.372.2 **2480**

An Investigation into some Fundamental Properties of Strip Transmission Lines with the Aid of an Electrolytic Tank.—Dukes. (See 2283.)

621.317.341.029.63 : 621.315.212 **2481**

Determination of the Attenuation of Coaxial Cables in the Frequency Range 300–1 000 Mc/s by Measurement of the Input and Output Voltage.—E. Scheffler & U. Queck. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 60–62.) The method described is suitable for tests on production lengths of cable. Details are included of a simple transformer section for use with specimens whose characteristic impedance differs from that of the test equipment.

621.317.342 : 621.317.755 **2482**

Group-Delay Measurements.—C. J. Heuvelman & A. van Weel. (*Wireless Engr*, May 1956, Vol. 33, No. 5, pp. 107–113.) "A description is given of a simple group-delay meter which, in combination with any conventional wobbulator generator, gives the group-delay characteristic directly on an oscilloscope. An automatic-gain-control circuit, necessary to maintain a constant level at the output of the network under test, enables the tracing of the amplitude characteristic on a second oscilloscope at the same time. Calibration of amplitude and group-delay scales is possible for any oscilloscope used. A sensitivity of 1 mμs can be achieved. The frequency range is 20–45 Mc/s."

621.317.361 : 621.384.612 **2483**

Bevatron-Frequency Measurement System.—W. M. Brobeck & W. C. Struven. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 182–187.) Digital counter techniques in conjunction with a c.r.o. display are used to monitor the relation of oscillator frequency to magnetic-field intensity during the acceleration period of the bevatron.

621.317.373 : 621.317.755 **2484**

Phase-Angle Measurement.—C. H. Vincent. (*Wireless Engr*, May 1956, Vol. 33, No. 5, pp. 113–117.) A c.r.o. method due to Fleming (*J. Instn elect. Engrs*, Nov. 1925, Vol. 63, No. 347, pp. 1045–1046) is discussed in which X and Y deflections are adjusted for equality and the phase difference is deduced from the resulting ellipse. Analysis indicates that lack of accuracy due to geometrical factors [1740 of 1953 (Benson)] is avoidable if reasonable precautions are taken.

621.317.42 **2485**

Methods of Measurement of Magnetic Field.—V. Andresciani. (*Ricerca sci.*, Jan. 1956, Vol. 26, No. 1, pp. 25–63.) A survey including methods based on the Hall effect in semiconductors and on nuclear magnetic resonance. 60 references.

621.317.42 **2486**

General Conditions to be satisfied by an Exploring Coil for measuring an Arbitrary Magnetic Field at a Point, giving Fourth-Order Terms.—P. Gautier. (*C. R. Acad. Sci., Paris*, 26th March 1956, Vol. 242, No. 13, pp. 1707–1710.) The possibility of eliminating the second-order terms with an exploring coil of finite volume is linked with the fact that the induction satisfies the Laplace equation.

621.317.42 : 621.317.715 **2487**

Characteristic Properties of Overdamped Galvanometers used as Partial Fluxmeters.—É. Selzer. (*C. R. Acad. Sci., Paris*, 12th March 1956, Vol. 242, No. 11, pp. 1422–1425.)

621.317.7 : 621.374.3 **2488**

A Novel Circuit for Electronic Measurements.—Abdel-Halim Ahmed. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, p. 1049.) Digest of paper in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, May 1955, Vol. 74, pp. 194–204. A square wave is applied to two valves operated as cathode followers, in push-pull, so that they are cut off alternately in phase with the a.c. signal input and at the signal frequency. The resulting average anode current is a measure of $I \cos \phi$, or $V \cos \phi$, where I, V and $\cos \phi$ are the current, voltage and power factor of the circuit measured. The instrument may be adapted to measure any of these quantities, or the power.

621.317.72 **2489**

A Note on the Theory of Oscillating-Electrode Voltmeters.—J. Rawcliffe. (*Proc. Instn elect. Engrs*, Part A, Feb. 1956, Vol. 103, No. 7, pp. 55–56.) "It has been tacitly assumed hitherto that the theory of the oscillating-electrode voltmeter derived for direct voltages applies equally well for alternating voltages if r.m.s. values are substituted for direct values. A rigorous treatment shows that this is not the case."

621.317.72 : 621.316.722.4 **2490**

A Voltage Divider containing a Nonlinear Unit.—L. L. Alston. (*Proc. Instn elect. Engrs*, Part A, Feb. 1956, Vol. 103, No. 7, pp. 52–54.) Analysis is presented for a voltage divider in which the low-voltage arm is shunted by a SiC resistor; the arrangement was designed primarily for measuring the burning voltage of an arc.

621.317.729 : 621.372 **2491**

The Determination of Complicated Wave Fields by means of Multidimensional *LC* Networks.—H. Schneider. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 70–76.) Networks of the general type described by Spangenberg et al. (3066 of 1949) have been designed at Darmstadt, using cable sections for the individual elements. As an example of use of the model, the determination of the field near a slot aerial is described.

621.317.729 : 621.396.621.54 **2492**

New Field Intensity Measuring.—Fuse & Soma. (See 2525.)

621.317.737 : 621.385.029.6 **2493**

An X-Band Magnetron *Q*-Measuring Apparatus.—J. R. G. Twisleton. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 339–343.) The apparatus described is of the type in which a directional coupler is used in conjunction with a frequency-sweep oscillator and c.r.o. to monitor the power reflected from the magnetron cavity. The measurement accuracy attainable by this method is discussed.

621.317.763.029.6 **2494**

The Rod Wavemeter for the Frequency Range 180–80 000 Mc/s—Construction and Measurement Results.—U. Adelsberger. (*Arch. elekt. Übertragung*, Feb. 1956, Vol. 10, No. 2, pp. 51–57.) A type of wavemeter developed at the Physikalisch-Technische Bundesanstalt comprises a coaxial line with sliding inner conductor (rod) of length less than that of the outer conductor; the line is thus open at one end and resonates when its length is an odd multiple of $\lambda/4$. This is advantageous from the point of view of accuracy, since the resonance positions for even generator harmonics do not coincide with those for odd harmonics. A model for mm-λ measurements has the outer conductor built up of quadrantal sections internally silvered and polished.

621.317.784.029.6 : 621.372.413 **2495**

A Resonant-Cavity Torque-Operated Wattmeter for Microwave Power.—R. A. Bailey. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 59–63.) The force on a small vane in a resonant cavity is a simple function of the Q factor, the power absorbed in the cavity, and the perturbation of the resonance frequency due to the vane. A sensitive measurement method based on these relations is described. Results obtained by this method and by the water-calorimeter method are compared. See also 220 of 1955 (Bailey et al.).

621.317.799 : 621.373.52 : 621.396.96.001.4 **2496**

Transistor Generator simulates Radar Target.—W. Eckess, J. Deavenport & K. Sherman. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 179–181.) Pulse-forming circuits for use in testing radar sets are described; either Ge or Si transistors may be used.

621.317 **2497**

Precision Electrical Measurements. Proceedings of a Symposium held at the National Physical Laboratory on 17–20 November, 1954. [Book Review]—Publishers: H.M. Stationery Office, London, 1955, 349 pp., 27s. 6d. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, p. 82.) The scope of the 26 papers ranges from precision methods of measuring physical properties, such as dielectric constant, to general surveys of testing techniques, such as impulse testing, and includes the appraisal of special properties of new materials, such as the microwave performance of magnetic dielectrics.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621-52 **2498**

An Introduction to the Analysis of Nonlinear Control Systems with Random Inputs.—J. F. Barrett & J. F. Coales. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 190–199.) In nonlinear systems with random inputs the probability distribution of the input has to be combined with that of the output in order to obtain that of the error function on which the output depends. When this is attempted, simultaneous integral equations are obtained; approximation methods of dealing with these are discussed. The possibility of using topological methods to investigate the stability of the systems is examined.

621-52 **2499**

A Three-Dimensional Machine-Tool Control System.—(*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 204–207.) Programming instructions taken from design drawings are worked out by an independent digital computer and recorded on magnetic tape which is used in a control unit to operate the machine tool. For measurement purposes an optical diffraction grating system is associated with each plane of the tool and in combination with a photosensitive detector produces a pulse train which is locked to the command pulse train through a servomechanism.

621.317.39 + 621-52 **2500**

Electronics in the Process Industries.—J. M. Carroll. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 138–145.) Measurement and control techniques used in chemical, petroleum and other continuous-flow plants are described.

621.317.39 : 620.179.1 **2501**

Prescribed-Function Vibration Generator.—P. M. Honnell. (*J. Brit. Instn Radio Engrs*, April 1956, Vol. 16,

No. 4, pp. 187–198.) Details are given of an arrangement developed for testing mechanical systems. It comprises a mask profiled to represent the prescribed function (e.g. a square or triangular waveform) rotating in front of a photocell, a vibrating platform being driven by the photocell amplifier.

621.317.79 : 539.1 : 538.569.4 **2502**

The Measurement, by Nuclear Resonance, of Light Water Concentration in Mixtures of Light and Heavy Water.—A. M. J. Mitchell & G. Phillips. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, pp. 67–72.) Two techniques for inducing r.f. power absorption are described, one suitable for H_2O concentrations in the range 7–100%, the other for low concentrations. In both cases the signal output rises almost linearly with H_2O concentration. A continuous flow method is also described.

621.384.6 **2503**

Design of the Pole Faces for Circular Particle Accelerators with the Electrolytic Tank.—F. Amman & L. Dadda. (*Nuovo Cim.*, 1st Jan. 1956, Vol. 3, No. 1, pp. 184–187. In English.)

621.385.833 **2504**

On the Magnification and Resolution of the Field-Emission Electron Microscope.—D. J. Rose. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 215–220.) Analysis of electron trajectories indicates that the existence of small protrusions on the field-emission tip may give rise to local areas of enhanced magnification; a resolution of 3 Å may be attained at these regions, so that some of their atomic detail should be observable.

621.385.833 **2505**

A Favorable Condition for seeing Simple Molecules in a Field-Emission Microscope.—J. A. Becker & R. G. Brandes. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 221–223.) Experimental evidence is presented confirming the analysis developed by Rose (2504 above).

621.385.833 **2506**

General Expressions and Typical Curves of Electro-optical Characteristics of Magnetic Electron Lenses.—P. Durandeau. (*C. R. Acad. Sci., Paris*, 26th March 1956, Vol. 242, No. 13, pp. 1710–1712.)

621.385.833 **2507**

Phase Contrast and Interchromatic Contrast: New Observation Methods in Electron Microscopy.—M. Locquin. (*C. R. Acad. Sci., Paris*, 26th March 1956, Vol. 242, No. 13, pp. 1713–1716.) Contrast is considerably increased by using an objective diaphragm with thinned edge in conjunction with illumination by a hollow cone of electrons.

621.385.833 **2508**

Investigation of Cylindrical Magnetic Lenses with Iron Armouring.—V. M. Kel'man & S. Ya. Yavor. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1405–1411.)

621.385.833 **2509**

Electron-Optical Equations for Wide Beams, taking Account of Chromatic Aberrations, and their Application to the Investigation of the Motion of Particles in Axially Symmetrical Fields.—Yu. V. Vandakurov. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1412–1425.)

621.386.8 : 621.383.2 : 620.179.1 **2510**

Intensification of the X-Ray Image in Industrial Radiology.—A. Nemet & W. F. Cox. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 345–355. Discussion, pp. 355–359.) The influence of brightness, blurring and contrast on the image resolution is examined. The improvement obtained by use of the image intensifier tube [1098 of 1953 (Teves & Tol)] is indicated.

621.387.424 **2511**

Analysis of Spuriousness of Geiger-Müller Tubes at High Temperatures.—S. P. Puri & P. S. Gill. (*Indian J. Phys.*, Jan. 1956, Vol. 30, No. 1, pp. 1–9.)

621.383 **2512**

Die Anwendung der Photozellen. [Book Review]—P. Goerlich. Publishers: Akademische Verlagsgesellschaft Geest & Portig K.G., Leipzig, 1954, 468 pp., DM 29. (*J. opt. Soc. Amer.*, Jan. 1956, Vol. 46, No. 1, pp. 73–74.) Comprises six chapters, dealing with the properties of photocells, the basic associated circuitry, applications for switching and control operations, photometry and recording, sound reproduction and image reproduction.

PROPAGATION OF WAVES

621.396.11 **2513**

Estimating the Ratio of Steady Sinusoidal Signal to Random Noise from Experimental Data.—M. L. Phillips. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, p. 692.) A family of curves is presented and a procedure is indicated facilitating determination of the required ratio, which is of particular interest in studies of scatter propagation, from observed values of the envelope of received field intensities.

621.396.11 : 551.510.535 : 523.78 **2514**

Ionospheric Observations at Banaras during the Total Solar Eclipse on 20 June 1955.—D. K. Banerjee, P. G. Surange & S. K. Sharma. (*J. sci. industr. Res.*, Nov. 1955, Vol. 14A, No. 11, pp. 517–521.) Field-strength measurements were made on signals from Colombo on 30·51 m λ and from Delhi on 30·71 m λ; vertical-incidence measurements were also made. The results are shown graphically and discussed; they indicate that the ionospheric eclipse lasted longer than the optical eclipse. An increase of the strength of the Colombo signals during the eclipse is attributed to reduction of absorption in the lower layers, while a reduction of the strength of the signals from Delhi is attributed to the reduced reflection coefficient associated with lowering of the electron density.

621.396.11.029.55 : 551.510.535 **2515**

Directional Observations on H.F. Transmissions over 2 100 km.—E. N. Bramley. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 295–300.) Direction-of-arrival measurements have been made using a wide-aperture spaced-loop direction finder. Pulse transmissions were used for most of the experiments, and first- and second-order F-reflections could usually be identified at 11 Mc/s. The bearing fluctuations of these echoes included a lateral-deviation component of about the magnitude expected from previous experiments at shorter distances. The rapid fluctuations were appreciably larger than at 700 km (3389 of 1955); night-time observations on 5 Mc/s indicated a standard deviation of 1·5° for individual bearings in an hourly period. The corresponding figure for the 1F echo in the day-time on 11 Mc/s was only 0·6°. The results were unaffected by changes made in the transmitting aerials and by ionospheric and magnetic storms.

621.396.11.029.62 : 523.5 **2516**

Observations of Short Bursts of Signal from a Distant 50-Mc/s Transmitter.—B. H. Briggs. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 171–183.) Analysis of reception over a distance of about 500 km strongly suggests that the majority, if not all, of the signals are deflected from meteor trails. In many cases the reflection point appears to be near the receiver rather than at the mid-point of the transmission path.

621.396.11.029.62 : 551.510.52 **2517**

Abnormal V.H.F. Propagation.—A. H. Hooper. (*Wireless World*, June 1956, Vol. 62, No. 6, pp. 295–298.) A method is indicated for constructing a graph showing variations of r.f. refractive index of the troposphere with height, using data derived from the daily meteorological observations of air pressure, dew point and temperature.

621.396.81.029.62 : 621.396.3 **2518**

V.H.F. Trans-horizon Communication Techniques.—Ringoen & Smith. (See 2532.)

621.396.812.3 : 551.510.535 **2519**

The Fading of Radio Waves of Frequencies between 16 and 2 400 kc/s.—S. A. Bowhill. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 129–145.) Night-time experiments using continuous waves reflected from the lowest ionosphere at nearly vertical incidence are discussed. Shallow fading with a quasi-period of 7 min is found in the frequency range 16–70 kc/s; above 70 kc/s fading with a quasi-period of about 1 min appears, increasing in depth with frequency. Ionosphere irregularities corresponding to ground dimensions of 5 km and 1 km, respectively, are indicated. The slow fading is due mainly to random ionospheric velocities of about 40 m/s, superimposed on which is a smaller, very variable, drift velocity. A D-region model is suggested.

621.396.812.3 : 551.510.535 **2520**

The Fading Periods of the E-Region Coupling Echo at 150 kc/s.—R. W. Parkinson. (*J. atmos. terr. Phys.*, March 1956, Vol. 8, No. 3, pp. 158–162.) From analysis of echoes returned from the coupling region lying below the main E layer, two dominant distributions of the fading periods have been found, centred on periods of 2 and 7 min. Possible causative mechanisms are discussed.

RECEPTION

621.376.33 **2521**

Theory of Detection of Frequency-Modulated Oscillations.—V. K. Turkin & G. A. Levin. (*C. R. Acad. Sci. U.R.S.S.*, 21st Feb. 1956, Vol. 106, No. 6, pp. 999–1002. In Russian.) The transmission of a f.m. signal through a tuned circuit or band-pass filter followed by a square-law detector is considered using new functions which are defined by series involving Bessel functions. The a.f. output is calculated for a particular case.

621.396.3 : 621.396.82 **2522**

Waveform of Radiotelegraph Signals and Interference between Adjacent Channels.—J. Marique. (*Ann. Télécommun.*, Feb. 1956, Vol. 11, No. 2, pp. 26–32.) The problem is attacked from the same general viewpoint as previously (3396 of 1955), consideration being given to the further case of pulses whose flanks are halves of Gaussian curves. The results indicate that no particular advantage accrues from use of this waveform.

621.396.621 : 621.376.3 : 621.396.82 **2523**

Impulse Noise in Narrow-Band F.M. Receivers.—S. P. Lapin & J. J. Suran. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, p. 1091.) Digest of paper in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, Sept. 1955, Vol. 74, pp. 450–454. Loss of signal due to noise transients is minimized by rounding the band-pass characteristic of the receiver so that, after the initial maximum, the amplitude of the transient decays more rapidly than in filters having a flat band-pass response curve.

621.396.621.029.62 : 621.376.332 **2524**

Unconventional F.M. Receiver.—M. G. Scroggie. (*Wireless World*, June 1956, Vol. 62, No. 6, pp. 258–262.) Complementary details are given of the receiver embodying the pulse-counter discriminator described previously (1861 of June). A single intermediate frequency of the order of 150 kc/s is used, to suit the discriminator.

621.396.621.54 : 621.317.729 **2525**

New Field Intensity Measuring.—S. Fuse & S. Soma. (*Rep. elect. Commun. Lab., Japan*, Oct. 1955, Vol. 3, No. 10, pp. 55–58.) The sensitivity of a double-heterodyne receiver used for measuring field strength and spurious signals is improved by narrowing the bandwidth. The problem of local-oscillator frequency stability is dealt with by sweeping the frequency of the second oscillator.

621.396.621.54 : 621.398 **2526**

Telemetering Receiver conserves Bandwidth.—M. S. Redden, Jr, & H. W. Zancanata. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 174–178.) A crystal-controlled double-superheterodyne receiver covering the range 216–247 Mc/s is described. Two second-i.f. amplifiers are provided, one with a bandwidth of 100 kc/s, for reception of p.w.m./f.m. data, and the other with a bandwidth of 500 kc/s, for f.m./f.m. data.

621.396.822 **2527**

Methods of solving Noise Problems.—W. R. Bennett. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 609–638.) "A tutorial exposition is given of various analytical concepts and techniques of proved value in calculating the response of electrical systems to noise waves. The relevant probability theory is reviewed with illustrative examples. Topics from statistics discussed include probability density, moments, stationary and ergodic processes, characteristic functions, semi-invariants, the central limit theorem, the Gaussian process, correlation, and power spectra. It is shown how the theory can be applied to cases of noise and signal subjected to such operations as filtering, rectification, periodic sampling, envelope detection, phase detection and frequency detection."

621.396.823 **2528**

Limits for Radio Interference in Germany and Other Countries.—G. Use. (*Elektrotech. Z., Edn A*, 11th Jan. 1956, Vol. 77, No. 2, pp. 33–40.) The methods of measurement of radio interference and the recommended limits are summarized for nine European countries, North America and Japan. 19 references.

STATIONS AND COMMUNICATION SYSTEMS

621.376.2 : 621.3.012.1 **2529**

A Vector Method for Amplitude-Modulated Signals.—C. J. N. Candy. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 410–415. Discussion, pp. 415–418.) Notation and analysis are presented facilitating calculations of the output of a demodulator. Examples show that when modulation frequency is comparable with carrier frequency, the modulation (or signal) may be appreciably modified by

impedances in the carrier channel. A complementary operational method for determining the response of circuits to nonsinusoidal a.m. signals is also described.

621.39.001.11 **2530**

Some Terminology and Notation in Information Theory.—I. J. Good. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 200–204.)

621.39.001.11 **2531**

The Arithmetical Characterization of Messages, and its Use for determining Correcting Networks.—M. Bayard & R. Roquet. (*Ann. Télécommun.*, Feb. 1956, Vol. 11, No. 2, pp. 33–45.) The message, or 'modulation phrase', is uniquely characterized by an 'index-number'; in the case of two-position telegraphy, which is examined in detail, this is given by

$$I = \sum_{n=0}^{n} \frac{\alpha_n}{2^n},$$

where n is the number of individual signals making up the message and α_n is the amplitude of an individual signal. For a given transmission system a curve can be traced showing the distortion of a reference signal at zero time as a function of I; from such curves, which take account of the effect of future signals, the appropriate correcting networks can be determined for obtaining a desired modification of the 'modulation phrase'.

621.396.3 : 621.396.81.029.62 **2532**

V.H.F. Trans-horizon Communication Techniques.—R. M. Ringoen & J. W. Smith. (*Electronics*, May 1956, Vol. 29, No. 5, pp. 154–159.) Possible techniques are reviewed with emphasis on the equipment requirements. It should be feasible to establish teleprinter links over distances up to 1 500 miles, in auroral regions, with reliability better than 99%.

621.396.3.029.55 **2533**

Observations and Experience at the Frankfurt a. Main Radio Exchange with the T.O.M. (Teletype on Multiplex) Equipment operated on Short-Wave Transmission Paths.—M. Corsepius & K. Vogt. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 55–59.) The observations indicate the improvements obtained by use of an automatic error-correction system. See also 2507 of 1954 (Hayton et al.).

621.396.41 : 621.376.5 : 621.396.65 **2534**

Pulse-Time-Modulation Terminals for Music Transmission over Radio Links.—R. F. Rous. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 283–292. Discussion, pp. 292–294.) A microwave link intended primarily for television is used alternatively to accommodate three music circuits and one engineer's circuit. Measurements indicate that signal/noise and signal/crosstalk ratios are satisfactory; operating over a 25-mile path there was a 20-dB margin in the signal/noise ratio over the value recommended by the C.C.I.R. The multiplexing circuit is described and performance figures are given.

621.396.65 : 621.396.41 **2535**

Radio-Link Network.—S. Montagnani. (*Poste e Telecomunicazioni*, Dec. 1955, Vol. 23, No. 12, pp. 884–894.) Account of the Bologna-Pisa trans-Appennine extension to the network described previously [2423 of 1955 (Bernardi)].

621.396.65.029.62 : 621.396.41 **2536**

Very-High-Frequency Radio Link between Puerto Rico and the Virgin Islands.—R. McSweeny. (*Elect. Commun.*, Dec. 1955, Vol. 32, No. 4, pp. 238–247; *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, Jan. 1956, Vol. 74, pp. 781–785.) Illustrated description of a two-stage link system with f.m. operation at frequencies between 150 and 160 Mc/s, providing several telephone and teleprinter channels.

621.396.65.029.63 : 621.396.41 **2537**

Microwave Relay System between Saint John and Halifax.—H. C. Sheffield. (*Elect. Commun.*, Dec. 1955, Vol. 32, No. 4, pp. 214–236; *Trans. Inst. Radio Engrs*, May 1956, Vol. CS-4, No. 2, pp. 144–167.) Detailed account of a time-division-multiplex radio link with five intermediate unattended repeaters. The 2-kMc/s transmission band is used. There are two multiplex equipments, each providing 32 voice channels, and three sets of r.f. equipment. Possible causes of interference are discussed and some performance figures are given.

621.396.71 **2538**

The New High-Frequency Transmitting Station at Rugby.—C. F. Booth & B. N. MacLarty. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 263–278. Discussion, pp. 278–282.) Comprehensive description of this British Post Office radio-communication station. A short account was abstracted previously (569 of February).

621.396.932 + 621.396.96 **2539**

Modernisation of Radio and Radar Equipment in H. M. Telegraph Ships.—W. Dolman & P. W. J. Gammon. (*P.O. elect. Engrs' J.*, Jan. 1956, Vol. 48, Part 4, pp. 204–207.)

621.396.975 : 621.395.623.8 **2540**

Wireless Sound Systems.—Hargens. (See 2278.)

SUBSIDIARY APPARATUS

621.311.6 : 537.311.33 : [546.28 + 546.289 **2541**

The Electron-Voltaic Effect in Germanium and Silicon *P-N* Junctions.—Kappaport, Loferski & Linder. (See 2437.)

621.311.6 : 621.383.5 : 539.165 **2542**

The Effect of Radioactive Radiation on a Photocell.—Pasynkov. (See 2567.)

621.311.6 : 621.39 **2543**

Automatic Control of Power Equipment for Telecommunications and Other Essential Services.—A. Watkins. (*J. Brit. Instn Radio Engrs*, April 1956, Vol. 16, No. 4, pp. 227–238.) "Two types of no-break generating sets are described: an all-electric battery operated equipment, and a diesel electric equipment. Detailed descriptions are given of three electronic devices used with these sets: (*a*) a static exciter automatic voltage regulator making use of two saturated transductors; (*b*) an alternator synchronizer in which the generator and mains voltages are compared in a triode circuit; (*c*) speed regulator using a thyratron which feeds the control field of the d.c. motor and also incorporates alarm and protection devices."

621-526 **2544**

Servomechanism Analysis. [Book Review]—G. J. Thaler & R. G. Brown. Publishers: McGraw-Hill, New York and London, 1953, 414 pp., 60s. (*Nature, Lond.*, 28th April 1956, Vol. 177, No. 4513, p. 766.) Gives the mathematical background for the analysis and design of servomechanisms, including a clear introduction to the theory of Laplace transformations.

TELEVISION AND PHOTOTELEGRAPHY

621.397.241 **2545**

The Provision of Circuits for Television Outside Broadcasts.—M. B. Williams & J. B. Sewter. (*P.O. elect. Engrs' J.*, Oct. 1955 & Jan. 1956, Vol. 48, Parts 3 & 4, pp. 166–170 & 234–238.) Technique and equipment for transmitting video signals over telephone pairs is described, including a new video repeater [see also 275 of January (Sewter & Wray)] and equipment for injecting vision signals into main coaxial-cable television links operated in the frequency ranges 3–7 Mc/s and 0·5–4 Mc/s.

621.397.26 : 621.396.65 **2546**

Microwave Television Radio Relay System.—O. H. Appelt, K. Christ & K. Schmid. (*Elect. Commun.*, Dec. 1955, Vol. 32, No. 4, pp. 248–254.) English version of paper originally published in German (538 of 1954).

621.397.5 **2547**

Phonevision—an Effective Method for Subscription Television.—A. L. C. Webb & A. Ellett. (*J. Brit. Instn Radio Engrs*, April 1956, Vol. 16, No. 4, pp. 205–219.) Paper reprinted from *Proc. Instn Radio Engrs, Aust.*, Oct. 1955, Vol. 16, No. 10, pp. 341–353.

621.397.5 : 535.623 **2548**

The Principles of N.T.S.C. Color Television.—C. J. Hirsch. (*J. Instn elect. Engrs*, Feb. 1956, Vol. 2, No. 14, pp. 89–97.)

621.397.5 : 778.5 **2549**

Television Studio Practices relative to Kinescope Recording.—H. Wright. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1956, Vol. 65, No. 1, pp. 1–6.) The problem of maintaining the correct brightness levels is considered in relation to the signal waveform.

621.397.5(083.74) **2550**

Fundamentals of the Television Standards adopted in Uruguay.—M. Giampietro. (*Rev. telegr. Electronica*, Jan. 1956, Vol. 44, No. 520, pp. 11–12, 16.) The various considerations such as mains frequency, international interchangeability, requirements for colour operation and magnetic recording, involved in the choice of standards are indicated. The standards adopted are 525 lines 60 fields for monochromatic operation and N.T.S.C. standards for colour, in accordance with F.C.C. recommendations except in respect of the difference between maximum and minimum transmitter levels and the channel spacings.

621.397.61 : 621.318.57 **2551**

Electronic Switches for Television.—A. M. Spooner. (*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 196–199.) Circuits for switching between video signals are discussed. The causes of switching transients are indicated and a transient-free switch is described in which a cathode-coupled triode pair, with a pentode for the common cathode impedance, feeds a series-connected double diode.

621.397.611.2 **2552**

The Problem of Inertia Effects in the Vidicon.—W. Heimann. (*Arch. elekt. Übertragung*, Feb. 1956, Vol. 10, No. 2, pp. 73–76.) Inertia effects were shown previously (2451 of 1955) to be due to photoelectric inertia in the target and to the nature of the charge-storage and signal-generating mechanisms, the latter being the more important. Experiments were made using target layers of different thicknesses and different scanned areas; the results confirmed the importance of obtaining the appropriate value for the capacitance of the picture elements. Measurements were made of the layer thickness by means of an interference microscope, and values of the capacitance were hence determined.

621.397.7 **2553**

Television Satellite Systems.—C. B. Plummer. (*Trans. Inst. Radio Engrs*, March 1955, No. PGBTS–1, pp. 65–66.) A brief discussion of television coverage problems in the U.S.A. precedes separate papers dealing with particular installations, as follows:—

U.H.F. Satellite Transmitter-Receiver Design and Operation.—L. Katz & T. B. Friedman (pp. 67–74; abstract, *Proc. Inst. Radio Engrs*, May 1955, Vol. 43, No. 5, p. 640).

The Engineering Aspects of a U.H.F. Booster Installation—J. Epstein (pp. 75–80; abstract as above).

A Report on U.H.F. Satellite Operation.—J. R. Whitworth (pp. 81–82).

An Experimental On-Channel Satellite Booster System.—J. H. DeWitt, Jr, G. A. Reynolds & L. E. Rawls (pp. 83–102).

621.397.7 : 535.623 : 621.3.06 **2554**

Color Video Switching.—W. B. Whalley & R. S. O'Brien. (*J. Soc. Mot. Pict. Telev. Engrs*, Jan. 1956, Vol. 65, No. 1, pp. 16–19.) Precautions taken to minimize the effect of capacitances in the studio switching equipment on the phase and amplitude response to the chrominance signal are described.

621.397.743 : 621.317.2 **2555**

The New Independent-Television Network.—S. H. Granger. (*P.O. elect. Engrs' J.*, Jan. 1956, Vol. 48, Part 4, pp. 191–197.) The structure of the system is outlined, with descriptions of the London studio links and inter-city networks and details of overall performance.

TRANSMISSION

621.396.61 : 621.375.232 **2556**

A Method of deriving Overall Negative Feedback Voltage in Transmitters.—D. Smart. (*J. Brit. Instn Radio Engrs*, April 1956, Vol. 16, No. 4, pp. 221–223.) Greater ease of frequency changing, greater linearity and reduced phase shift, drift and cost result if the feedback voltage is derived from a resistor in the earth return of the power amplifier valve rather than by the conventional method of rectifying part of the modulated output.

VALVES AND THERMIONICS

621.3.011 : 621.396.822 **2557**

Physical Sources of Noise.—Pierce. (See 2308.)

621.314.63 : 546.289 : 621.396.822 **2558**

Measurement of Noise Spectra of a Germanium *p-n* Junction Diode.—F. J. Hyde. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 231–241.) "Measurements have been made of the excess noise generated in a fused-alloy-type *p-n* junction diode in the frequency range 0·12 c/s to 2 Mc/s at 29°C with the reverse direct current I as parameter. The observed noise spectral density may be synthesized from three well-defined types of component: (*a*) an extensive component proportional to f^{-1} directly observed over five decades, and by synthesis assumed to exist over as many as seven decades of frequency; (*b*) a component proportional to $(1 + \omega^2\tau_1^2)^{-1}$ associated with a single relaxation time τ_1; (*c*) a uniform component associated with the 'shot'

noise of the measured current I, for frequencies less than $1/2\pi\tau_p$ where τ_p is the hole lifetime. τ_1 was found to increase with increasing I while the intensity of the f^{-1} component increased more rapidly than in proportion to I^2."

621.314.63 : 621.319.4 **2559**

A Variable-Capacitance Germanium Junction Diode for U.H.F.—L. J. Giacoletto & J. O'Connell. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 68–85; *RCA Special Publication, Transistors I*, 1956, pp. 221–238.) The significance of various design factors for the performance of alloy-junction diodes is considered with reference to use of the diodes as voltage-controlled capacitors when biased in the reverse direction. For a particular diode with a bias of 6 V the capacitance was 38 $\mu\mu$F and the voltage variation of capacitance was 3 $\mu\mu$F/V; the lead inductance was 2·6 mμH and the effective series resistance 0·5 Ω. The Q value was very high at the lower radio frequencies, decreasing to 17 at 500 Mc/s.

621.314.632 : 546.817.221 **2560**

Analysis of H_2S-Treated PbS Point-Contact Rectifiers.—V. G. Bhide, J. N. Das & P. V. Khandekar. (*Proc. phys. Soc.*, 1st Feb. 1956, Vol. 69, No. 434B, pp. 245–248.) Measurements were made on natural and synthetic crystals originally of n-type but converted to p-type, to a certain depth, by heating in a H_2S atmosphere and used in combination with various metal points. The values obtained for α, the slope of the semi-log plot of the I/V characteristic, are near the theorctical value of 40 V^{-1}, whereas the values of α for the original n-type material are considerably lower. The significance of the results is discussed briefly.

621.314.7 **2561**

Some Experiments on, and a Theory of, Surface Breakdown (in transistors).—C. G. B. Garrett & W. H. Brattain. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 299–306.) The experiments were performed on n-p-n alloy-junction transistors as used by Wahl & Kleimack (2243 of July). The procedure followed was to measure photocurrent point by point for voltages first below and then above breakdown value. Results indicate that surface breakdown, like body breakdown, is an avalanche process; the multiplication sets in at a particular spot. High breakdown voltage is encouraged by arranging that the polarity of the surface charge is such as to produce a 'channel' over the material of the higher-resistivity side, and by surrounding the unit with a medium of high dielectric constant.

621.314.7 **2562**

Uniform Planar Alloy Junctions for Germanium Transistors.—C. W. Mueller & N. H. Ditrick. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 46–56; *RCA Special Publication, Transistors I*, 1956, pp. 121–131.) Technique is described for obtaining flat junctions, by separating the wetting from the alloying steps. As a consequence, the upper limit on operating frequency is considerably raised.

621.314.7 **2563**

***P-N-P* Transistors using High-Emitter-Efficiency Alloy Materials.**—L. D. Armstrong, C. L. Carlson & M. Bentivegna. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 37–45; *RCA Special Publication, Transistors I*, 1956, pp. 144–152.) "The addition of small percentages of gallium or aluminum to indium, for use as the emitter alloy, produces greatly improved high-current characteristics. As compared with pure indium, the use of gallium alloys improves emitter efficiency by about 3·5 times, and the use of aluminum-bearing alloys by about 10 times. Techniques for preparation of the alloys and results of tests on transistors using the various emitters are described. Volume lifetime is measured as a function of injection level to permit comparison with the theoretical equations for current amplification factor. These measurements are discussed briefly, and a revised equation for current amplification factor at high currents is given."

621.314.7 : 537.311.33 : 546.28 **2564**

Surface Treatment of Silicon for Low Recombination Velocity.—Moore & Nelson. (See 2439.)

621.383.4 : 546.289 : 621.396.822 **2565**

Technique for Improving the Signal-to-Noise Ratios of Single-Crystal Photoconductive Detectors.—R. M. Page, R. W. Terhune & J. Hickmott, Jr. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 307–308.) Correlation technique adapted from that used by Montgomery (122 of 1953) is briefly described. The detector is a Ge filament, and the light source a neon lamp modulated at 1 kc/s.

621.383.5 : 537.311.33 **2566**

Photovoltaic Effect in GaAs p-n Junctions and Solar Energy Conversion.—D. A. Jenny, J. J. Loferski & P. Rappaport. (*Phys. Rev.*, 1st Feb. 1956, Vol. 101, No. 3, pp. 1208–1209.) Measurements on several cells are reported and the results are compared with theoretical predictions. The highest value obtained for the efficiency of conversion of solar energy is 6·5%, which is of the same order as values obtained for Si and CdS, but higher values are to be expected as the technique of preparing the cells is improved.

621.383.5 : 539.165 : 621.311.6 **2567**

The Effect of Radioactive Radiation on a Photocell.—V. V. Pasynkov. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1376–1385.) Experiments conducted on a Se barrier-layer photocell indicate that the effect of β-radiation is similar to that of a light beam. It is suggested that with the aid of artificial radioactive isotopes small low-power electric batteries can be constructed which would not be damaged by short circuits and which would have a very long working life.

621.385 : 537.533 **2568**

Instability of Electron Beams subjected to a Magnetic Field.—B. Epsztein. (*C. R. Acad. Sci., Paris*, 12th March 1956, Vol. 242, No. 11, pp. 1425–1428.) Analysis is presented to explain the breaking-up of a tubular beam observed by Webster (*J. appl. Phys.*, Nov. 1955, Vol. 26, No. 11, pp. 1386–1387). Instability can also occur without a magnetic field. The energy brought into play is derived entirely from the mutual repulsion of the electrons.

621.385.001.4 **2569**

A Simple Optical Method for determining Grid-Cathode Spacing in Electronic Valves.—W. Guber & W. Stetter. (*Nachrichtentech. Z.*, Feb. 1956, Vol. 9, No. 2, pp. 77–79.)

621.385.029.6 **2570**

The Design of High-Power Traveling-Wave Tubes.—M. Chodorow & E. J. Nalos. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 649–659.) The design of valves for pulsed powers of the order of 1 MW is discussed. Some success has been achieved with an experimental valve operating in the 3-kMc/s band, using a disk-loaded waveguide for slowing the wave. From results of measurements on this valve it is inferred that bandwidths of 10–20% should be attainable with reasonable efficiency. Modifications in attenuator, focusing and coupling systems likely to lead to improved performance are indicated.

621.385.029.6 **2571**

A Large-Signal Theory of Traveling-Wave Amplifiers.—P. K. Tien. (*Bell Syst. tech. J.*, March 1956, Vol. 35, No. 2, pp. 349–374.) The work of Nordsieck (2497 of 1953) and Tien et al. (1822 of 1955) is extended to take fully into account the effects of space-charge repulsion and of a finite coupling between electron beam and circuit. The energy associated with the backward wave is calculated and its effect on efficiency is discussed. Assuming typical values for the various parameters, values ranging from 23% to 40% are found for the saturation efficiency. Curves and tables are presented showing the voltage and phase of the circuit wave, the velocity spread of electrons and the fundamental component of the charge-density modulation.

621.385.029.6 **2572**

Travelling-Wave Tubes.—F. N. H. Robinson. (*Research, Lond.*, Jan. 1956, Vol. 9, No. 1, pp. 27–31.) Recent developments are briefly surveyed; space-periodic beam-focusing arrangements, nonreciprocal attenuators, improvements in noise figure, and backward-wave valves are mentioned. Over 30 references.

621.385.029.6 **2573**

Phase-Angle Distortion in Traveling-Wave Tubes.—W. R. Beam & D. J. Blattner. (*RCA Rev.*, March 1956, Vol. 17, No. 1, pp. 86–99.) A theoretical study is made of variations of phase velocity with supply voltages, signal level and matching conditions; Pierce's first-order theory (*Traveling-Wave Tubes*, 1950) is used. The results are in good agreement with measurements on a valve operating at 3 kMc/s, in which the following phase shifts were observed: 50° for 1% change in helix voltage; 2° for 1% change in first-anode voltage; about 0·1° for 1% change in magnet current; 6° for each mW increase of output power; 6° for each mW of power lost by reflection at the output coupler.

621.385.029.6 **2574**

Bihelical Traveling-Wave Tube with 50-dB Gain at 4 000 Mc/s.—W. P. G. Klein. (*Elect. Commun.*, Dec. 1955, Vol. 32, No. 4, pp. 255–262.) A 5-W valve suitable for microwave relay systems is discussed. In order to maintain the gain as near as possible to the small-signal value, two helices are provided, having separate d.c. circuits and coupled only by the beam; an attenuating section is arranged between the two helices, the second of which is shorter than the first. Measurements on several experimental valves are reported.

621.385.029.6 **2575**

On the Space Charge affected by the Magnetic Field.—Y. Yasuoka. (*J. phys. Soc. Japan*, Dec. 1955, Vol. 10, No. 12, pp. 1102–1109.) A study has been made of effects due to dense space charge constrained by a strong magnetic field. Special experimental tubes were used, with a tungsten-filament cathode and copper-block anode, and the cathode back-heating was measured in the absence and in the presence of the magnetic field. The measurements confirm the theory that the outermost electrons of the space-charge cloud are scattered by mutual interaction and have excess energies, thus giving rise to the back heating. When the anode voltage is made sufficiently high, these electrons are captured and oscillations, probably of plasma type, occur.

621.385.029.6 **2576**

Development of Traveling-Wave Tubes for 4 000-Mc/s Band.—K. Sato, D. Kobayashi, A. Kondo & J. Koyama. (*Rep. elect. Commun. Lab., Japan*, Oct. 1955, Vol. 3, No. 10, pp. 11–16.) Details are given of the design, construction and performance of several helix-type valves developed in Japan.

621.385.029.6 **2577**

The Cascade-Bunching of Electrons in Application to the Theory of the Multi-resonator Magnetron.—V. N. Shevchik. (*Zh. tekh. Fiz.*, Aug. 1955, Vol. 25, No. 8, pp. 1462–1470.) Attempts have been made in the literature to consider the operation of a magnetron from the standpoint of the interaction of the electron stream with the h.f. fields localized directly at the anode slots, as distinct from the method of the travelling wave; this treatment is developed further. A detailed analysis of the operation of a magnetron with a 'thick' cathode is given, the results are in good agreement with experimental data.

621.385.029.6 : 621.317.737 **2578**

An X-Band Magnetron *Q*-Measuring Apparatus.—Twisleton. (See 2493.)

621.385.029.6 : 621.373.423 **2579**

A Reflex-Klystron Oscillator for the 8–9-mm Band.—D. J. Wootton & A. F. Pearce. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 104–111.) Detailed description of the Type-VX5023 klystron; it is continuously tunable over the wavelength range 8–9 mm and is suitable for use in superheterodyne receivers and as a source for laboratory measurements.

621.385.029.65 **2580**

A Millimetre-Wave Magnetron.—J. R. M. Vaughan. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 95–103.) A detailed description is given of a fixed-tuned rising-sun magnetron Type-VX5027, for high-power pulse operation at 8·6 mm λ, designed in accordance with established principles. Design problems, performance and test procedure are discussed.

621.385.032.2 : 537.533 **2581**

A Detailed Analysis of Beam Formation with Electron Guns of the Pierce Type.—W. E. Danielson, J. L. Rosenfeld & J. A. Saloom. (*Bell Syst. tech. J.*, March 1956, Vol. 35, No. 2, pp. 375–420.) The theory of Cutler & Hines (2154 of 1955) is extended to cover the case when spread caused by thermal electron velocities is not small compared with nominal beam size; a lens correction for the finite size of the anode aperture is worked out. Charts are presented facilitating the choice of design parameters to produce a prescribed beam and experimental results confirming the theory are given.

621.385.032.21 **2582**

Some New Thermionic Cathodes.—F. A. Vick. (*Sci. Progr.*, Jan. 1956, Vol. 44, No. 173, pp. 65–71.) A brief progress review.

621.385.032.213.1 **2583**

Mutual Heating in Transmitting-Valve Filament Structures.—W. J. Pohl. (*Proc. Instn elect. Engrs*, Part C, March 1956, Vol. 103, No. 3, pp. 224–230.) Methods of calculating the effects of mutual heating between individual elements are described. A set of universal curves to facilitate application of the results to cylindrical structures is presented.

621.385.032.216 **2584**

Cathode Interface Impedance Desimplified.—H. B. Frost. (*Trans. Inst. Radio Engrs*, April 1955, No. PGRQC-5, pp. 27–33. Abstract, *Proc. Inst. Radio Engrs*, July 1955, Vol. 43, No. 7, p. 896.) To represent the cathode-interface impedance accurately, a *RC* network containing four elements is required. Gradual and sudden valve failures due to the growth of this impedance are discussed in relation to system reliability.

621.385.032.216 **2585**

Conduction Mechanism in Oxide-Coated Cathodes.—E. B. Hensley. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 286–290.) "Measurements have been made on a system composed of two parallel planar cathodes so arranged that their surfaces may be pressed together or separated by a small gap. Low-field conductivity measurements show that above approximately 700°K, the conductance of the system does not depend on physical contact between the cathode surfaces. This result supports the theory that the high-temperature conductivity is a property of the electron gas in the cathode pores. The ratio of conductivity to thermionic emission was measured under conditions designed to preserve the state of activation of the cathode surface. The results agreed with the theoretically predicted ratio and demonstrate that the higher values previously reported were caused by a lower activation on the surface than in the interior of the cathode."

621.385.032.216 **2586**

Equivalent Circuit for the Oxide-Coated Cathode.—R. E. J. King. (*J. appl. Phys.*, March 1956, Vol. 27, No. 3, pp. 308–309.) A new interpretation is presented of the equivalent circuit proposed by Tomlinson (3409 of 1954) to represent the two-mechanism conduction process in the cathode coating.

621.385.032.216 **2587**

Effects of Electrolysis in the Thorium Oxide Emitter.—D. L. Goldwater. (*J. Franklin Inst.*, March 1956, Vol. 261, No. 3, pp. 331–341.) The significance of electrolysis as a factor making for reduced life in thoria cathodes is discussed on the basis of studies on thoria crystals reported by Danforth & Bodine (2419 above), actual life data, and observations of the electrolysis of sintered thoria specimens.

621.385.032.7 **2588**

Electron Bombardment of the Glass Envelope of a Receiving Valve.—G. H. Metson & D. J. Sargent. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 334–338.) On being bombarded by electrons, the potential of the valve envelope is driven towards cathode potential if its initial value is such that the secondary emission coefficient δ is < 1, and towards anode potential if δ is > 1; this latter condition, termed 'lock-up', is stable. Experimental and theoretical investigations for a pentode with an oxide cathode indicate that the mechanisms by which the envelope acquires the initial positive potential corresponding to $\delta > 1$ include anode-voltage leakage, capacitive transfer of anode voltage, and photoelectric emission.

621.385.3.029.6 : 621.373.421 + 621.375.23 **2589**

A Grounded-Grid Valve System with High Stability Characteristics.—F. Exley & R. E. Young. (*Electronic Engng*, May 1956, Vol. 28, No. 339, pp. 202–203.) An arrangement suitable for an oscillator or r.f. amplifier using a 'lighthouse'-type valve is described in which the anode and cathode coaxial lines extend on either side of the grid plane.

621.385.832 **2590**

Some Half-Tone Charge-Storage Tubes.—R. S. Webley, H. G. Lubszynski & J. A. Ledge. (*Proc. Instn elect. Engrs*, Part B, May 1956, Vol. 103, No. 9, pp. 395–397.) Discussion on 3453 of 1955.

621.385.832 **2591**

Progress in the Development of Post-Acceleration and Electrostatic Deflection.—K. Schlesinger. (*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, pp. 659–667.) Practical forms of the single-deflection-centre 'deflectron' system (3290 of 1952) are formed by printing the electrodes on the insides of glass cylinders or cones. A post-acceleration, or intensifier, system suitable for use with this deflection system comprises a long drift space terminated by a double metal mesh close up to the screen, generally as described by Allard (1032 of 1951). Undesired secondary emission from this mesh is suppressed by providing an insulating coating on the first surface of the mesh while connecting the support metal to a potential lower than that of the drift space.

621.314.7 **2592**

Transistors and Other Crystal Valves. [Book Review]—T. R. Scott. Publishers: Macdonald and Evans, London, 1955, 258 pp., 45s. (*Brit. J. appl. Phys.*, Feb. 1956, Vol. 7, No. 2, pp. 82–83.) "This book has been written for engineers who may have to use crystal valves, rather than for those engaged in developing or designing them."

MISCELLANEOUS

061.4(43) : [621.39 + 621.317.7 **2593**

A Good Standard in Leipzig.—(*Funk-Technik, Berlin*, March 1956, Vol. 11, No. 6, pp. 155–163.) Radio and television receivers, magnetic tape recorders, valves, measuring instruments, components and other equipment shown at the Leipzig Industrial Fair are briefly described. East German, U.S.S.R., Czechoslovak, Hungarian and other products were exhibited.

621.3 : (06) **2594**

Transactions of the I.R.E. 1955 Index.—(*Proc. Inst. Radio Engrs*, May 1956, Vol. 44, No. 5, 24 pp. following p. 732.) Includes contents lists, author and subject indexes and 'nontechnical index'.

621.37/.39].004.6 **2595**

Reliability in Complex Electronic Equipment.—G. H. Scheer. (*Elect. Engng, N.Y.*, Dec. 1955, Vol. 74, No. 12, pp. 1062–1065.) A statistical study is presented of operational failures of various types of components used in air-borne military equipment; ways of reducing failures are briefly indicated.

621.37/.39].004.6 **2596**

The Definition of Terms of Interest in the Study of Reliability.—C. R. Knight, E. R. Jervis & G. R. Herd. (*Trans. Inst. Radio Engrs*, April 1955, No. PGRQC-5, pp. 34–56. Abstract, *Proc. Inst. Radio Engrs*, July 1955, Vol. 43, No. 7, p. 896.)

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.01 **2597**

Group Theory of Vibrations of Symmetric Molecules, Membranes, and Plates.—M. A. Melvin & S. Edwards, Jr. (*J. acoust. Soc. Amer.*, March 1956, Vol. 28, No. 2, pp. 201–216.) "It is shown that the detailed group-theoretical analysis of molecular vibrations can be extended to continuous bodies of various shapes by regarding them as the limits of discrete systems with the number of particles becoming indefinitely large."

534.121.2 **2598**

On the Vibrations of Triangular Membranes.—S. K. L. Rao. (*J. Indian Inst. Sci.*, Section B, Jan. 1956, Vol. 38, No. 1, pp. 1–3.) Analysis is presented for the free-edge case.

534.2 **2599**

The Propagation and Reflection of Sound Pulses of Finite Amplitude.—T. F. W. Embleton. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 382–395.) "Experimental results are discussed, covering many aspects of the propagation and reflection of finite amplitude sound pulses and weak shock fronts. These are compared with theory and show amongst other features (*a*) that an N-shaped wave form tends to shorter on reflection and (*b*) that a shock front disappears on reflection at an open-ended tube."

534.23 **2600**

Determination of the Amplitude Distribution on Plane Surfaces from the Directional Distribution of the Radiation Fields.—K. Fehér. (*Arch. elekt. Übertragung*, March & April 1956, Vol. 10, Nos. 3 & 4, pp. 125–131 & 163–173.) Theory based on Fourier analysis of the radiation pattern is supported by results of measurements on vibrating plates.

534.232-8 **2601**

Experimental Characteristics of Continuously-Variable-Resonant-Frequency Crystal Systems.—F. Dunn, F. J. Fry & W. J. Fry. (*J. acoust. Soc. Amer.*, March 1956, Vol. 28, No. 2, pp. 275–280.) The characteristics of the transducer described in 2813 of 1955 (Fry et al.) are presented graphically and are discussed.

534.24 + [538.566 : 535.42 **2602**

Variational Method for the Calculation of the Distribution of Energy reflected from a Periodic Surface: Part I.—W. C. Meecham. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 361–367.)

534.612 **2603**

Anomalous Behavior of Rayleigh Disk for High-Frequency Waves.—J. Awatani. (*J. acoust. Soc. Amer.*, March 1956, Vol. 28, No. 2, pp. 297–301.)

534.75 : 533.723 **2604**

How Loud is Silence?—C. E. White. (*Audio*, March 1956, Vol. 40, No. 3, pp. 17–19, 68.) A quantitative discussion of the relation between thermal noise level and hearing threshold.

534.78 : 621.39 **2605**

Speech Bandwidth Compression.—W. E. Kock. (*Bell Lab. Rec.*, March 1956, Vol. 34, No. 3, pp. 81–85.) The basic principles of operation of three systems, the 'Vocoder', 'Audrey' and 'Vobanc', are described.

534.845 **2606**

Measurements on Resonant Absorbent Acoustic Structures.—E. Brosio. (*Alta Frequenza*, Feb. 1956, Vol. 25, No. 1, pp. 32–37.) Laboratory measurements on plastic membranes are reported. Curves show the variation of absorption coefficient with frequency for different distances of the membrane from the wall and for different materials, etc.

534.85/.86 : 534.76 **2607**

Two-Channel Stereophonic Sound Systems.—F. H. Brittain & D. M. Leakey. (*Wireless World*, July 1956, Vol. 62, No. 7, pp. 331–334.) Continuation of paper abstracted in 1946 of July, giving practical details of the equipment used.

534.86 : 061-3(47) **2608**

Scientific Symposium on Electroacoustics.—B. D. Tartakovski. (*Uspekhi fiz. Nauk*, Feb. 1956, Vol. 58, No. 2, pp. 347–358.) Summaries are given of 17 papers read at the symposium held at Kiev, 1st–5th July 1955.

2609
621.395.623.7 + 621.395.625.3 + 621.375.029.3] : 061.4

Developments in Sound Reproduction.—(*Wireless World*, July 1956, Vol. 62, No. 7, pp. 335–339.) Equipment shown at the London Audio Fair, the British Sound Recording Association's exhibition and the Radio Components Show is described.

621.395.625.3 **2610**

New 16-mm Magnetic Signal-Level Test Film.—(*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1956, Vol. 65, No. 2, p. 110.) A film providing a reference level for measurements based on work by Schwartz et al. (1864 of 1955).

621.395.625.3 **2611**

Field Strength and Gap Distribution Function in the [magnetic] **Reproducing Head with and without Tape.**—J. Greiner. (*NachrTech.*, Feb. 1956, Vol. 6, No. 2, pp. 63–70.) Analysis is presented for six different types of gap. The field distribution is closest to ideal for the ring head, the longitudinal component having a nearly rectangular waveform and the transverse component being largely suppressed.

621.395.625.3 : 538.221 **2612**

The Process of the Magnetization of Magnetic Tape.—W. Guckenburg. (*J. Soc. Mot. Pict. Telev. Engrs*, Feb. 1956, Vol. 65, No. 2, pp. 69–72.) A method for making visible a magnetic recording on tape involves softening the agent binding the magnetic particles so that the magnetic forces between the particles can produce mechanical displacement. It is possible to examine recordings of wavelengths $< 0{\cdot}4$ mil. The azimuth angles of the recording head can be measured to within $\pm 1'$ of arc.

AERIALS AND TRANSMISSION LINES

621.372 **2613**

Electromagnetic Properties of a Medium comprising Thin Layers.—S. M. Rytov. (*Zh. eksp. teor. Phys.*, Nov. 1955, Vol. 29, No. 5(11), pp. 605–616.) A medium comprising alternate thin layers of two different isotropic materials behaves effectively as a uniform but anisotropic medium. The tensors of the effective permittivity and permeability are derived as functions of the parameters of the materials and of the frequency. The losses and boundary conditions at the surface of the medium are also considered. The theory is relevant to laminated lines of the general type described by Clogston (e.g. 2908 of 1951).

621.372.2 **2614**

Line Transmission Circuits.—E. D. Fitton & R. E. Howland. (*Wireless Engr*, June 1956, Vol. 33, No. 6, pp. 143–150.) An examination is made of effects in transmission-line pairs and associated apparatus due to longitudinal currents and voltages which may be introduced by either e.m. or e.s. coupling. Complex waveforms transmitted along a line in the presence of such currents or voltages will suffer undesired modification. To keep this effect as small as possible, not only should the line pairs be screened and twisted, but the terminal-to-earth impedances should be accurately balanced. Details of suitable techniques are discussed, with numerical illustrations.

621.372.2 **2615**

Investigation of the Energy Exchange and the Field Distribution for Parallel Surface-Wave Transmission Lines.—D. Marcuse. (*Arch. elekt. Übertragung*, March 1956, Vol. 10, No. 3, pp. 117–124.) The coupling between two parallel surface-wave lines is calculated by considering them as a two-wire system, different initial conditions being represented by the superposition of co-phase and opposed-phase waves on the two lines. With identical lines, the whole of the current fed into one of them is coupled into the other at a distance along the line termed the 'exchange length'. The presence of a dissimilar conductor near a surface-wave line is shown to impair the field concentration.

621.372.2 : 621.396.677.75 **2616**

Diffraction of Surface Electromagnetic Waves. Application to the Theory of the Dielectric Aerial.—G. Weill. (*Ann. Radioélect.*, July 1955, Vol. 10, No. 41, pp. 228–255.) Radiation losses from dielectric-coated single conductors are analysed and related to the operation of dielectric aerials. Diffraction of the surface wave at discontinuities of the dielectric permittivity or surface impedance is particularly considered. Methods used and results obtained in measurements of phase along a line with variable characteristics are discussed; phase-velocity anomalies have been observed on rhombic aerials. The characteristics of some end-fire aerials $80\ \lambda$ long are described.

621.372.22 **2617**

Bibliography of Nonuniform Transmission Lines.—H. Kaufman. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 218–220.)

621.372.8 : 538.221 : 538.6 **2618**

Calculation of the Faraday Effect in a Gyroparamagnetic Medium.—J. Soutif-Guicherd. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1868–1871.) Continuation of work reported previously (2289 of August) on propagation in waveguides containing a gyromagnetic medium. Formulae are derived for the absorption and the rotation of the plane of polarization.

621.372.8 : 621.316.726 **2619**

Propagation of Electromagnetic Waves in Circular Waveguides with Finite Wall Conductivity, at Frequencies near Cut-Off.—W. Schaffeld & H. Bayer. (*Arch. elekt. Übertragung*, March 1956, Vol. 10, No. 3, pp. 89–97. Correction, *ibid.*, April 1956, Vol. 10, No. 4, p. 173.) Analysis is presented applicable to all possible E and H modes. Calculations of the propagation constants are based on the assumption of an infinitely thick wall, this approximation being satisfactory for all actual thicknesses $> 0{\cdot}1$ mm. The results were verified experimentally for H_{11} mode propagation. The high slope of the attenuation/frequency characteristic near cut-off is used as the basis of a method for stabilizing klystron oscillators; the effectiveness of the method is improved by introducing a suitable gas filling in the waveguide.

621.372.8 : 621.385.029.6 **2620**

Nonlinear Phenomena in a Waveguide in the Presence of an Electron Beam with Nearly Equal Electron and Wave Velocities.—Loshakov. (See 2914.)

621.396.67 **2621**

On an Error in the Use of the Method of Integral Equations in the Theory of Aerials.—B. V. Braude. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1819–1824.)

621.396.674.3 **2622**

Some Comments on Wide-Band and Folded Aerials.—E. O. Willoughby. (*Proc. Instn Radio Engrs, Aust.*, March 1956, Vol. 17, No. 3, pp. 79–87.) "The impedance-frequency characteristic of simple cylindrical aerials is discussed and it is shown that the bandwidth may be considerably improved by the use of appropriate correcting networks. The folded type of aerial automatically makes use of some of these principles. Folded aerials with equal and unequal legs are considered and experimental results illustrating the analysis are given."

621.396.676 : 621.398 **2623**

A Multiple Telemetering Antenna System for Supersonic Aircraft.—R. E. Anderson, C. J. Dorrenbacher, R. Krausz & D. L. Margerum. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 173–176.) A system comprising three independent aerials for three separate telemetering transmitters operating in the frequency band 216–235 Mc/s makes use of the existing angle-of-attack indicator and ram-pressure tubes.

621.396.676.029.6 : 621.3.012.12 **2624**

Patterns of Stub Antennas on Cylindrical Structures.—J. R. Wait & K. Okashimo. (*Canad. J. Phys.*, Feb. 1956, Vol. 34, No. 2, pp. 190–202.) A theoretical investigation relevant to microwave aerials for aircraft is reported. Radiation patterns are presented for radial electric dipoles located on an insulated cylinder and on a cylindrically tipped half-plane. The patterns are in reasonable agreement with those obtained experimentally by Bain (*Stanford Research Inst. tech. Rep.* No. 42, April 1953).

621.396.676.2 **2625**

Current Distribution on Wing-Cap and Tail-Cap Antennas.—I. Carswell. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 207–212.)

621.396.677 **2626**

A New Antenna Feed having Equal E- and H-Plane Patterns.—A. C[h]lavin. (*Trans. Inst. Radio Engrs*, July 1954, Vol. AP-2, No. 3, pp. 113–119; *Proc. Instn Radio Engrs, Aust.*, March 1956, Vol. 17, No. 3, pp. 88–93. Abstract, *Proc. Inst. Radio Engrs*, July 1954, Vol. 42, No. 7, p. 1197.) The design of feeds for circular paraboloids is discussed.

621.396.677.3 **2627**

Cross Section of Colinear Arrays at Normal Incidence.—J. M. Minkowski & E. S. Cassedy. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 313–317.) The back-scattering cross-section of collinear arrays of thin dipoles is derived by the variational method, for normally incident waves. The case of the two-dipole array is investigated particularly. Measurements made using the method described by Scharfman & King (2310 of 1954) confirm the validity of the theory.

621.396.677.7/.8 **2628**

Horn-Parabola Aerials for Wide-Band Directional Radio Systems.—H. Laub & W. Stöhr. (*Frequenz.*, Feb. 1956, Vol. 10, No. 2, pp. 33–44.) Detailed discussion is presented of the radiation properties of aerials comprising parabolic sectors illuminated at high angle and formed as integral structures with the primary radiator. A particular aerial designed for operation at 4 kMc/s centre frequency can be adapted to operate at 6 kMc/s by suitably modifying the waveguide-to-horn transition in the primary radiator. Two channels can be provided by radiating waves polarized at right angles to one another. Another type of aerial suitable for television transmissions is a paraboloid of revolution excited axially; this can be provided with extensions to reduce the intensity of side lobes.

621.396.677.71 **2629**

Radiation Patterns of Slotted-Elliptic Cylinder Antennas.—J. Y. Wong. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 200–203). Continuation of theoretical work reported previously (3482 of 1953). The results can be applied to determine the patterns radiated by very thin slotted cylinders such as wing and tail surfaces of aircraft.

621.396.677.71 **2630**

The Application of Mathieu Functions in computing the Field Distribution of an Aerial from its Directional Characteristic.—A. A. Pistol'kors. (*NachrTech.*, March 1956, Vol. 6, No. 3, pp. 128–129.) German version of paper abstracted previously from the Russian (3468 of 1954).

621.396.677.833 **2631**

The Curved Passive Reflector.—E. Bedrosian. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 168–173.) Analysis for aerial reflectors with slightly curved surfaces indicates that with appropriate illumination the gain can be increased indefinitely by increasing the size. In systems in which the reflector is at the top of a tower and the illuminating aerial at the foot, the effect of reducing tower height is to widen the main lobe of the radiated pattern and to reduce the level of side lobes.

AUTOMATIC COMPUTERS

681.142 **2632**

A New Serial Digital Decoder.—S. V. Soanes. (*Electronic Engng*, June 1956, Vol. 28, No. 340, pp. 247–249.) Intermediate storage and an amplifier feedback loop are used, making the decoder practically independent of clock timing pulses. It can also be used in an analogue system to solve certain types of polynomial equation.

681.142 **2633**

Interconnection of Electronic Computers.—(*Tech. News Bull. nat. Bur. Stand.*, March 1956, Vol. 40, No. 3, pp. 33–35.) Brief account of experiments on the joint operation of the SEAC and DYSEAC machines on business data-processing work; the former machine transmits control signals to the latter via a cable.

681.142 **2634**

Design and Construction of Small Automatic Computers with Programming Arrangement, at the Higher Technical School in Dresden.—I. Lemann. (*Avtomatika i Telemekhanika*, Jan. 1956, Vol. 17, No. 1, pp. 3–18.) Illustrated description of a computer which includes about 600 valves and measures 290 × 180 × 60 cm; the control desk is separate. A magnetic-drum store is used.

681.142 **2635**

Principles and Application of Electronic Analogue Computers.—P. Heggs. (*Electronic Engng*, March–June 1956, Vol. 28, Nos. 337–340, pp. 120–122, 168–170, 212–215 & 257–259.) Typical examples of electrical analogues and the equipment for producing them are discussed and general design considerations are presented. The Saunders-Roe general-purpose analogue computer is described.

681.142 **2636**

New Electronic Analogue Apparatus of the Institute of Automatics and Telemechanics of the U.S.S.R. Academy of Sciences.—V. V. Gurov, B. Ya. Kogan, A. D. Talantsev & V. A. Trapeznikov. (*Avtomatika i Telemekhanika*, Jan. 1956, Vol. 17, No. 1, pp. 19–35.) An illustrated description, including block and circuit diagrams, of the EMU-5 comprising a unit for solving linear differential equations of up to the sixth order, a unit for solving nonlinear differential equations and a power supply unit as well as additional special-purpose units.

681.142 **2637**

Design of a Timing Device and Nonlinear Units for an Electronic Differential Analyser.—V. C. Rideout, N. S. Nagaraja, S. Sampath, V. N. Chiplunkar & L. S. Manavalan. (*J. Indian Inst. Sci.*, Section B, Jan. 1956, Vol. 38, No. 1, pp. 66–79.)

681.142 : 621.3 **2638**

Basic Circuits used in Digital Automation.—M. L. Klein, F. K. Williams & H. C. Morgan. (*Instrum. & Automation*, Feb. 1956, Vol. 29, No. 2, pp. 271–279.) Commonly used circuits are described from a practical point of view, with circuit diagrams and details of components.

681.142 : 621.374.32 **2639**

An Economical Relay-Operated Accumulator.—J. K. Wood. (*Electronic Engng*, June 1956, Vol. 28, No. 340, pp. 250–253.) Design details are given of a binary adder with a maximum capacity of about 2^{24}.

681.142 : 621.385.832 **2640**

The Hyperbolic-Field Tube, an Electron-Beam Tube for Multiplication in Analogue Computers.—Schmidt. (See 2924.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3.012.1 : 621.372.4 **2641**

Impedance and Admittance Surfaces.—R. Merten. (*Arch. Elektrotech.*, 3rd Feb. 1956, Vol. 42, No. 4, pp. 205–216.) Three-dimensional locus diagrams are used to investigate the variation of impedance (or admittance) and phase displacement in two-pole circuits in response to variations of frequency, resistance, inductance or capacitance. The impedance and admittance surfaces include straight lines corresponding to the important special case of zero phase displacement, when the impedance is independent of the damping or detuning.

621.3.066.6 **2642**

Bridge and Short-Arc Erosion of Copper, Silver, and Palladium Contacts on Break.—W. B. Ittner, III. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 382–388.)

621.314.22.029.3 : 621.375.23 **2643**

Transformer Design for 'Zero' Impedance Amplifiers.—N. R. Grossner. (*Audio*, March 1956, Vol. 40, No. 3, pp. 27–30, 69.) Lamination-weight reductions of up to 42% may be obtained without increased distortion in a transformer designed for an a.f. 'zero-impedance' output stage [e.g. 1390 of 1950 (Miller)]. Design formulae are given.

621.316.726 : 621.396.6 **2644**

The Stabilidyne.—M. Colas. (*Onde élect.*, Feb. 1956, Vol. 36, No. 347, pp. 83–93.) A method for applying the harmonics of a quartz crystal oscillator to control the frequency of a receiver or transmitter is described. For reception, the signal frequency and a suitable harmonic of the crystal oscillator are separately mixed with oscillations from a common local oscillator and the two products are then mixed to obtain a frequency which is the difference between that of the signal and the crystal harmonic. Stability of the order of ± 50 c/s with a signal frequency of 30 Mc/s is readily obtained. The characteristics of several industrial equipments are described.

621.316.727 **2645**

A 90°-Phase-Shift Circuit for a Wide Frequency Range.—O. Limann. (*Elektronik*, Feb. 1956, Vol. 5, No. 2, p. 46.) A *CR* and a *RC* network are combined in such a way that the undesired phase changes at the outputs of the individual networks due to a frequency change cancel one another in the combined output.

621.318.424 **2646**

Calculations for Ferroxcube-Pot-Cored Coils.—J. Arrazau. (*Onde élect.*, March 1956, Vol. 36, No. 348, pp. 252–267.) A method of calculating core dimensions and windings is presented, giving results accurate to within 10–15%.

621.318.5 **2647**

Ferroresonant Computing Circuits.—R. S. Arbon & G. Phylip-Jones. (*Wireless World*, July 1956, Vol. 62, No. 7, pp. 324–330.) The basic ferroresonant circuit and applications to switching and counting devices are described.

621.318.57 **2648**

The Equilibrium States of a Bistable Flip-Flop from the Point of View of Reliable and Stable Operation.—M. Bataille. (*Onde élect.*, Feb. 1956, Vol. 36, No. 347, pp. 94–103.) The influence of individual components on the functioning of the Eccles-Jordan circuit is discussed and permissible tolerances for given performance are determined.

621.319.4 : 621.375.5 **2649**

Influence of an Alternating Voltage and a Direct Voltage on a Nonlinear Capacitor.—J. C. Hoffmann. (*C. R. Acad. Sci., Paris*, 23rd April 1956, Vol. 242, No. 17, pp. 2122–2124.) Families of curves are presented showing measured variations of capacitance and tan δ as functions of a direct voltage and a 2-kMc/s voltage, applied simultaneously, for a capacitor with $BaTiO_3$ dielectric. The curves facilitate determination of optimum working point for dielectric amplifiers.

621.372.41 : 534.01 **2650**

Linear Systems.—B. Gross. (*Nuovo Cim.*, 1956, Supplement to Vol. 3, No. 2, pp. 235–296. In German.) The method of analysis presented previously (2245 of 1953) is developed; the treatment is applicable to all linear passive resonator systems, whether damped or undamped.

621.372.41 : 534.01 **2651**

Possibility of Free Oscillations in a Variable-Parameter Resonant System.—E. Cambi. (*Nuovo Cim.*, 1956, Supplement to Vol. 3, No. 2, pp. 137–181. In English.) Comprehensive general analysis is presented for time-variable linear systems.

621.372.412 + 621.373.421.13 + 537.227/228.1 **2652**

Papers presented at the 2nd Conference on Piezoelectricity (Moscow, 26th–29th April 1955).—(See 2770.)

621.372.412 : 621.372.5 **2653**

The Equivalent Network of a Piezoelectric Crystal with Divided Electrodes.—B. van der Veen. (*Philips Res. Rep.*, Feb. 1956, Vol. 11, No. 1, pp. 66–79.) A general equivalent circuit is worked out for the crystal treated as a quadripole, for frequencies close to that of mechanical resonance.

621.372.413 **2654**

Spherical-Frustum Cavities.—G. Boudouris. (*Onde élect.*, Feb. 1956, Vol. 36, No. 347, pp. 104–121.) Symmetrical spherical-frustum cavities are studied as intermediate cases between the sphere and the cylinder. Resonance wavelengths and Q factors are determined by Abele's method (3823 of 1947). A wavemeter using a hemispherical cavity partly filled with Hg is proposed. Curves are presented showing the variation of Q with cavity size, for $\lambda \sim 3$ cm and 10 cm.

621.372.413 **2655**

Theory of Coupled Endovibrators [cavity resonators]**: Part 2.**—A. I. Akhiezer & G. Ya. Lyubarski. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1597–1603.)

Continuation of work noted previously (658 of 1955). A mathematical analysis is given of the propagation of waves in a chain of cavity resonators coupled by long narrow slots.

621.372.413 **2656**

Electromagnetic Oscillations in a Parabolic Tube as a Particular Case of the Interaction of Two Cavities through a Throat.—E. R. Mustel'. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1788–1799.) Free oscillations in a tube of parabolic profile and rectangular cross-section are considered. The tube is regarded as consisting of two cavities interacting through the throat. The wave equation is derived and solutions are found for the cases where the two cavities are (*a*) identical and (*b*) not identical. Experimental results are in good agreement with the theoretical conclusions.

621.372.413 : 621.317.335.3 **2657**

Calculation of the Natural Frequency of a Π-type [single re-entrant] **Cavity Partly Filled with an Absorbing Dielectric.**—V. L. Patrushev. (*C. R. Acad. Sci. U.R.S.S.*, 21st March 1956, Vol. 107, No. 3, pp. 409–412. In Russian.) The system considered comprises a re-entrant cylindrical cavity resonator with a solid dielectric specimen in the form of a truncated cone placed between the base of the cylinder and the butt end of the inner conductor. Formulae derived for the natural frequency and the damping can be used also to determine the components of the complex dielectric constant of the specimen; this analysis also provides the theoretical basis of the measurement method described by Works (173 of 1948) and others.

621.372.413 : 621.318.134 **2658**

Ferrites in Resonant Cavities.—R. A. Waldron. (*Brit. J. appl. Phys.*, March 1956, Vol. 7, No. 3, p. 114.) A formula is derived for the frequency shift produced by introducing a sphere of ferrite into a resonant cavity.

621.372.5 **2659**

Parallel-T *RC* Network.—G. V. Buckley. (*Wireless Engr*, July 1956, Vol. 33, No. 7, pp. 168–173.) A simplified design method is presented based on finding an equivalent network which is more amenable to mathematical treatment.

621.372.5.01 **2660**

A Note on Bandwidth.—A. Nathan. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 788–790.) The concept of bandwidth is examined in relation to networks such as integrators, which are not designed to provide faithful transmission of a waveform. The bandwidth of such a network is defined as the maximum bandwidth of the input signal for which the output does not differ from that of an ideal network by more than a prescribed amount.

621.372.54 **2661**

Resistance-Capacitance Filter Networks with Single-Component Frequency Control.—W. K. Clothier. (*Trans. Inst. Radio Engrs*, March 1955, Vol. CT-2, No. 1, pp. 97–102. Abstract, *Proc. Inst. Radio Engrs*, May 1955, Vol. 43, No. 5, p. 641.)

621.372.54.029.42 : 621.375 **2662**

A Practical Method of designing *RC* Active Filters.—R. P. Sallen & E. L. Key. (*Trans. Inst. Radio Engrs*, March 1955, Vol. CT-2, No. 1, pp. 74–85.) A method for designing filters for the frequency range below about 30 c/s, with sharp cut-off, is based on consideration of five basic variables, namely, two resistances, two capacitances, and the gain; from these, further practical parameters are derived by taking the products of resistance and capacitance, the ratio of resistances, and the ratio of capacitances. The active elements can in many cases be simple cathode-follower circuits. Design data for a number of different cases are tabulated.

621.372.542.3.029.4 : 621.375.23 **2663**

The Design of Low-Frequency High-Pass *RC* Filters.—D. D. Crombie. (*Electronic Engng*, June 1956, Vol. 28, No. 340, pp. 254–256.) The design of a twin-T network incorporated in a feedback amplifier circuit is discussed and details are given relating frequency response to phase shift in the amplifier. The use of compensating sections for securing a flat pass-band characteristic is considered and a practical example is worked out.

621.372.543.3 **2664**

New Rejector Circuit: Bifilar-T Trap.—H. J. Orchard; W. P. Wilson. (*Wireless Engr*, July 1956, Vol. 33, No. 7, pp. 175–177.) Comments on 1993 of July (Cocking).

621.372.57 **2665**

Theory of Noisy Four-Poles.—H. Rothe & W. Dahlke. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 811–818.) English version of paper originally published in German (2568 of 1955).

621.373.4 **2666**

Nonlinear Coupled Systems.—L. Sideriades. (*C. R. Acad. Sci., Paris*, 4th April 1956, Vol. 242, No. 14, pp. 1784–1787.) Analysis applicable to valve oscillator circuits generally is presented. Different types of oscillator are distinguished topologically.

621.373.421.1 **2667**

Amplitude Limitation in *LC*-Oscillators.—Z. Akçasu. (*Wireless Engr*, June 1956, Vol. 33, No. 6, pp. 151–155.) "An *LC*-oscillator which includes two biased diodes in the grid circuit to limit oscillation amplitude is analysed. Amplitude of oscillation and harmonic distortion are calculated and represented by curves. From these curves it is observed that oscillations can be modulated linearly; no frequency modulation occurs during amplitude modulation and harmonic distortion is very low. Also the circuit is found to be adequate for high frequency stability. The distinctive feature of the circuit is shown to be that the static conditions of the valve, such as bias voltage and direct anode current, are independent of the oscillation amplitude. A practical circuit is described."

2668

621.375.029.3 + 621.395.623.7 + 621.395.625.3] :061.4

Developments in Sound Reproduction.—(See 2609.)

621.375.13 **2669**

Docile Behavior of Feedback Amplifiers.—S. J. Mason. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 781–787.) "A docile amplifier is one that remains stable when connected to any passive network of a specified class. A simplified geometrical approach is used to derive the docility criteria for passive-end-loading, ideal-transformer feedback, bilateral passive feedback, and arbitrary passive feedback."

621.375.221.2 **2670**

Notes on the Design of Distributed Amplifiers.—G. Fidecaro & A. M. Wetherell. (*Nuovo Cim.*, 1st Feb. 1956, Vol. 3, No. 2, pp. 359–370. In English.) The treatment used takes account of the self-capacitance of

the coils and the effect of using anode and grid lines with different propagation speeds; the latter effect can be useful in avoiding the large increase in gain of the *m*-derived filter-type amplifier at the upper end of the band.

621.375.232.9 **2671**

Differential Amplifiers with Asymmetrical Output.—E. Giua. (*Alta Frequenza*, Feb. 1956, Vol. 25, No. 1, pp. 4–14.) The basic circuit discussed comprises a pair of similar triodes with equal resistances in anode and cathode leads; when equal-phase voltages are applied to the two grids, voltages in phase opposition are produced at the cathode of one valve and the anode of the other; the output is taken from the mid-point of the circuit connecting these two points. Theory of operation is presented and two experimental models are described.

621.375.3 **2672**

Design of Push-Pull Magnetic Power Amplifiers.—N. P. Vasil'eva. (*Avtomatika i Telemekhanika*, Jan. 1956, Vol. 17, No. 1, pp. 53–65. Addendum, *ibid*, April 1956, Vol. 17, No. 4, p. 361.) The method is described in detail and is illustrated by discussion of a 120-W amplifier with a power amplification of 500 and internal feedback.

621.375.3 **2673**

Principles of Construction of Magnetic Amplifiers with a Low Sensitivity Threshold.—M. A. Rozenblat. (*Avtomatika i Telemekhanika*, Jan. 1956, Vol. 17, No. 1, pp. 66–77.)

621.375.3 **2674**

High-Frequency Operation of Magnetic Amplifiers.—H. W. Collins. (*Elect. Engng, N.Y.*, Jan. 1956, Vol. 75, No. 1, p. 53.) Digest of paper published in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, Sept. 1955, Vol. 74, pp. 500–505. Operation at high frequency (e.g. 200 kc/s) makes possible power gains and bandwidths unattainable at power frequencies, since a given power can be controlled with a smaller core.

621.375.4 : 621.314.7 **2675**

[The design of circuits using] **Junction Transistors at High Frequencies.**—J. Vasseur. (*Onde élect.*, March 1956, Vol. 36, No. 348, pp. 230–251.) Methods of stabilizing transistor amplifiers are discussed and formulae are presented for calculating the characteristics of a linear amplifier at any frequency, and for determining the principal parameters of junction transistors with common-emitter, common-base, or common-collector connections. Curves are given of maximum gain as a function of frequency.

GENERAL PHYSICS

53.05 **2676**

The Successive Derivation of Experimental Laws.—P. Vernotte. (*C. R. Acad. Sci., Paris*, 16th April 1956, Vol. 242, No. 16, pp. 1966–1968.) Refinement of the method of smoothing experimental curves described previously (2345 of August).

530.162 : 519.2 **2677**

On the Use of Gram-Charlier Series to represent Noise.—C. W. Horton. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 350–355.) The stochastic time series produced by the random occurrence of identical events is considered. If the waveforms corresponding to the individual events and to the resulting autocorrelation function and power spectrum are each represented by a Gram-Charlier series, relatively simple relations exist between the different sequences of coefficients. If the noise bandwidth is not too great, the number of terms in the series is small enough to permit computation. The formulae are applied to the analysis of experimental data for noise associated with reverse current in a Si diode.

534.2-16 : 537.21 **2678**

On the Theory of the Acousto-Electric Effect.—A. Van Den Beukel. (*Appl. sci. Res.*, 1956, Vol. B5, No. 6, pp. 459–468.) When an acoustic wave passes through an insulated solid it gives rise to an electric field in the direction of propagation. The influence on this phenomenon of thermal lattice vibrations at temperatures above the Debye temperature is investigated theoretically. The calculations indicate that the field is proportional to both the intensity and frequency of the acoustic wave. The effect is so small that it would not generally be observable in Cu, but is larger by several orders of magnitude in Ge.

535.37 : 061.3(47) **2679**

4th Symposium on Luminescence (Molecular Luminescence and Luminescence Analysis).—B. S. Neporent & P. P. Feofilov. (*Uspekhi fiz. Nauk*, Jan. 1956, Vol. 58, No. 1, pp. 151–164.) Brief summaries are given of about 50 papers read at the symposium held at Minsk, 20th–25th June 1955.

535.515 **2680**

Birefringence resulting from the Application of an Intense Beam of Light to an Isotropic Medium.—A. D. Buckingham. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 344–349.)

537/538 **2681**

A New Model of Classical Electron.—P. Caldirola. (*Nuovo Cim.*, 1956, Supplement to Vol. 3, No. 2, pp. 297–343. In English.)

537.122 **2682**

Electron Physics Tables.—L. Marton, C. Marton & W. G. Hall. (*Nat. Bur. Stand. Circulars*, 30th March 1956, No. 571, 83 pp.) Eight parameters are tabulated relating to the energy and motion of electrons accelerated by a potential difference.

537.122 **2683**

Magnetic Moment of the Electron.—P. Kusch. (*Science*, 10th Feb. 1956, Vol. 123, No. 3189, pp. 207–211.) A survey of experimental and theoretical work, indicating evidence of anomalies.

537.22 : 621.315.616 **2684**

Electrostatic Charges in Plastics.—S. M. Skinner, J. Gaynor & G. W. Sohl. (*Mod. Plast.*, Feb. 1956, Vol. 33, No. 6, pp. 127–136, 246.) "Experimental evidence is presented that the 'static' charge on plastics is a volume charge distribution rather than a surface distribution. The charge contained in a plastic that has been in contact with metal is found to drain out of the plastic by a flow process which depends both upon the resistivity of the plastic and upon the possibility of neutralization of surface charges by opposite charges external to the plastic such as in air."

537.312.8 **2685**

Field Dependence of Magnetoconductivity.—J. W. McClure. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1642–1646.) A theoretical calculation is made of the dependence of the elements of the conductivity tensor on the magnetic field for the case of a crystal with arbitrary energy-band structure. The results are the same as would be given by a superposition of electron gases whose cyclotron frequencies are related harmonically. The

strengths of the harmonics depend on the band structure. The diagonal elements of the conductivity tensor are monotonically decreasing functions of the magnetic field strength.

537.5 **2686**

The Characteristics of a Discharge at a Probe at a Positive Potential and the Measurement of the Associated Gas Density.—B. N. Klyarfel'd, A. A. Timofeev, N. A. Neretina & L. G. Guseva. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1581–1596.)

537.5 **2687**

On the Floating Probe Method for the Measurement of Ionized Gas.—K. Yamamoto & T. Okuda. (*J. phys. Soc. Japan*, Jan. 1956, Vol. 11, No. 1, pp. 57–68.) Revised expressions are obtained for the positive-ion current and electron temperature for the usual double-probe method. A triple-probe method is proposed for measurement of energy distribution in electrodeless or h.f. discharges and the applicability of the techniques is discussed.

537.5 : 538.566 **2688**

Formulae for the Mean Losses of Energy in Collisions of Slow Electrons moving in Diatomic Gases.—L. G. H. Huxley. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 44–53.) Approximate formulae are derived which correspond closely with results of experiments for electrons of low energy. The formulae are relevant to the theory of interaction of radio waves.

537.52 : 538.561 **2689**

Two-Electrode High-Frequency Discharge at Pressures from 100 mm Hg to Atmospheric.—G. S. Solntsev & M. M. Dmitrieva. (*Zh. eksp. teor. Phys.*, Nov. 1955, Vol. 29, No. 5(11), pp. 651–657.) An experimental investigation is reported of discharges in nitrogen and argon at frequencies of 35 to 36 Mc/s and 1·5 Mc/s. Variation of running-voltage with electrode separation and variation of electric field with pressure are shown graphically and photographs of discharges are reproduced.

537.533 **2690**

Theoretical Interpretation of Field Emission Experiments.—T. J. Lewis. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1694–1698.) Experimental results obtained by various workers on field emission from tungsten and barium-on-tungsten surfaces are discussed in relation to theories regarding the nature of the surface potential barrier and the distortion of the field by space charge.

537.56 : 538.56 **2691**

Kinetic Theory of the Lorentz Gas: Case of 'Maxwellian' Molecules.—M. Bayet. (*J. Phys. Radium*, Feb. 1956, Vol. 17, No. 2, pp. 167–168.) Discussion of differences between the views and results of the author (e.g. 2925 of 1954) and those of Jancel & Kahan (1366 of May, 2196 of 1954, etc.).

537.56 : 538.6 **2692**

Use of the Boltzmann Equation for the Study of Ionized Gases of Low Density.—(*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 12–27.)

Part 1.—K. M. Watson (pp. 12–19).

Part 2.—K. A. Brueckner & K. M. Watson (pp. 19–27).

The behaviour of the gas in a strong magnetic field is discussed.

537.562 : 538.56 **2693**

On the Dipole Resonant Mode of an Ionized Gas Column.—G. H. Keitel. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 144–147.) Calculations show that the multiple resonances found by Makinson & Slade (3532 of 1954) were created by the discontinuities in their approximation to the Gaussian function, and that the actual Gaussian distribution exhibits only one resonance. See also *Proc. Inst. Radio Engrs*, Oct. 1955, Vol. 43, No. 10, pp. 1481–1487.

538.3 **2694**

Fundamental Equations of a Classical Non-conservative Electromagnetism.—E. Durand. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1862–1865.)

538.311 : 621.318.4 **2695**

The Computation of Coils for producing Uniform Magnetic Fields and Constant Field Gradients.—W. Berger & H. J. Butterweck. (*Arch. Elektrotech.*, 3rd Feb. 1956, Vol. 42, No. 4, pp. 216–222.) Calculations for Helmholtz-coil systems are presented. For the field at the mid-point on the axis to be uniform, the second derivative of the field in the axial direction must be zero at that point; for the field gradient to be constant, the third derivative must vanish. Families of curves suitable for design purposes are derived.

538.566 **2696**

Incidence of Electromagnetic Waves on Double Infinite Grids.—Ya. N. Fel'd. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1956, Vol. 107, No. 1, pp. 71–74. In Russian.) The system considered comprises a double grid of parallel metal rods; the grids are spaced a apart and the rods in each grid are spaced l apart, the rods in one grid being staggered by an amount d relative to the rods in the other grid; the radius of the rods is r_0. Calculations are made of the reflection coefficient $|R|$ and the refractive index $|Q|$ corresponding to three values of a/λ, for $l = 0{\cdot}2\lambda$, $d = 0{\cdot}1\lambda$ and $r_0 = 0{\cdot}01\lambda$, for normal incidence; with $a/\lambda = 0{\cdot}25$, $|R| = 0{\cdot}994$ and $|Q| = 0{\cdot}110$.

538.566 : 535.13 **2697**

A Method for integrating Maxwell's Equations.—R. Vallée. (*Onde élect.*, Feb. 1956, Vol. 36, No. 347, pp. 122–133.) Maxwell's equations for propagation of e.m. waves are integrated for the case where the functions representing the wave contours are separable. Applications are discussed showing the relation between the e.m. theory and geometrical optics.

538.566 : 535.42] + 534.24 **2698**

Variational Method for the Calculation of the Distribution of Energy reflected from a Periodic Surface: Part 1.—W. C. Meecham. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 361–367.)

538.566 : 535.42 **2699**

Experimental Study of the Diffraction of Microwaves by Rotationally Symmetrical Apertures.—A. Boivin, A. Dion & H. P. Koenig. (*Canad. J. Phys.*, Feb. 1956, Vol. 34, No. 2, pp. 166–178. In French.) Measurements at 1·25 cm λ have been made using circular and annular apertures. The results indicate that diffraction calculations based on Kirchhoff's approximation are accurate to within 5% at planes as close as twice the diameter of the aperture, the accuracy improving as the distance increases.

538.566 : 535.42 **2700**

Rigorous Solution of a Particular Diffraction Phenomenon.—P. Poincelot. (*Ann. Télécommun.*, March 1956, Vol. 11, No. 3, pp. 50–56.) Diffraction of a plane e.m. wave by a perfectly conducting infinitely thin

screen is analysed, using an infinite system of algebraic equations and an infinite number of unknowns, for the case of the electric vector parallel to the screen edges. The procedure is to calculate the vector potential for the surface assuming a sinusoidal distribution of parallel straight-line currents. Extension of the method to the more general case of arbitrary direction of electric vector would be feasible using electronic computers.

538.566 : 537.56 **2701**

Structure of a Magnetohydrodynamic Shock Wave in a Plasma of Infinite Conductivity.—H. K. Sen. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 5–11.) The analysis presented is relevant to problems of solar r.f. radiation, the ionosphere, and cosmic rays.

538.566 : 537.56 : 621.385.029.6 **2702**

Growing Electric Space-Charge Waves.—J. H. Piddington. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 31–43.) Theory presented previously, purporting to explain the operation of the electron-wave valve and the origin of solar r.f. emission, is shown to be unsound; alternative theory is given. See also 2258 of July.

538.569.4 : 547.556 **2703**

Some Measurements on the Spectral Line Shape and Width of a Paramagnetic Resonance Absorption Line.—F. Bruin & M. Bruin. (*Physica*, Feb. 1956, Vol. 22, No. 2, pp. 129–140.) Measurements on αα-diphenyl-β-picryl hydrazyl at a frequency of about 20 Mc/s are reported.

538.691 **2704**

The Motion of Charged Particles in Weakly Variable Magnetic Fields.—G. Hellwig. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 508–516.) Analysis is simplified by considering in place of the actual particle, which follows a helical path, an equivalent particle following a mean path and having a magnetic moment.

548.0 : 539.11 **2705**

Interaction of Excitons with Lattice Vibrations in Polar Crystals: Part I.—H. J. G. Meyer. (*Physica*, Feb. 1956, Vol. 22, No. 2, pp. 109–120.)

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **2706**

Early History of Radio Astronomy.—G. C. Southworth. (*Sci. Mon.*, Feb. 1956, Vol. 82, No. 2, pp. 55–66.)

523.16 **2707**

Cosmic Radio Sources Observed at 600 Mc/s.—J. H. Piddington & G. H. Trent. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 74–83.) A survey has been made over most of the celestial sphere between declinations 90° S and 51° N, using a narrow pencil beam. 49 discrete sources giving flux densities of about 10^{-24} W/m² per c/s were identified, including 18 which may not have been previously reported. Nearly all the discrete sources are associated with irregularities of the background radiation.

523.16 **2708**

Radio Emission from Novae and Supernovae.—B. Y. Mills, A. G. Little & K. V. Sheridan. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 84–89.) "Attempts have been made to observe the radio emission at 3·5 m from two supernovae and ten novae. Kepler's star was the only reasonably certain identification. A comparison with radio observations of other supernova remnants suggests a constant ratio between the present radio emission and the maximum emission of light. It is concluded that for common novae, which are not detectable as radio sources, this ratio must be smaller than for supernovae. The galactic radio emission near the plane of the Milky Way could be largely the integrated emission of supernova remnants but common novae could not contribute appreciably."

523.16 **2709**

The Masses of the Magellanic Clouds from Radio Observations.—F. J. Kerr & G. de Vaucouleurs. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 90–111.)

523.16 : 523.4 **2710**

18·3-Mc/s Radiation from Jupiter.—C. A. Shain. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 61–73.) An examination of records at Sydney shows that bursts at 18·3 Mc/s observed in 1950–1951 and previously ascribed to a terrestrial cause were in fact due to radiation from Jupiter; this confirms the observations of Burke & Franklin (2933 of 1955). Some new observations are also mentioned. The usefulness of Jupiter radiation for studying propagation conditions near the sun is pointed out. See also 406 of February.

523.16 : 523.991 **2711**

Observation of an Eclipse of the Crab Nebula.—A. Boischot, E. J. Blum, M. Ginat & E. Le Roux. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1849–1852.) Report of observations at frequencies of 169 and 900 Mc/s during the occultation of the Crab nebula by the moon, on 24th January 1956. The radio source corresponds closely to the visible structure of the nebula; it is deduced from this result that the electron density in the lunar atmosphere is $< 10^4/cm^3$.

523.165 : 523.746 **2712**

The Daily Variation of the Cosmic Ray Intensity Measured near the 1954 Sunspot Minimum.—M. Possener & I. J. van Heerden. (*Phil. Mag.*, March 1956, Vol. 1, No. 3, pp. 253–260.)

523.5 : 551.510.535 **2713**

A Note on the Interpretation of Transient Echoes from the Ionosphere.—A. C. B. Lovell. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 293–294.) Comment on a note by Shain & Kerr (3075 of 1955). Recent radio-echo work on meteors shows that a midday maximum is often observed in the rate of occurrence of meteors. Observations with narrow-beam aerials on 70 Mc/s show that a tendency during the months October–March for the main peak to occur at 0600 is completely reversed from April to September, when the major peak occurs during the daytime.

523.7 : 538.12 **2714**

The Sun's General Magnetic Field.—H. Alfvén. (*Tellus*, Feb. 1956, Vol. 8, No. 1, pp. 1–12.)

523.75 : 551.594.6 **2715**

The Solar Outburst, 23 February 1956. Observations by the Royal Greenwich Observatory.—T. Gold & D. R. Palmer. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 287–291.) Cosmic-ray, photographic and magnetic observations are presented; records of the intensity of atmospherics on a frequency of 27 kc/s show a very substantial decrease in received signal level at 0345 U.T., which appears to be attributable to the cosmic-ray increase associated with the flare.

523.75 : 551.594.6 **2716**

A Long-Wave Anomaly associated with the Arrival of Cosmic-Ray Particles of Solar Origin on 23 February 1956.—M. A. Ellison & J. H. Reid. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 291–293.) Records of atmospherics received on a frequency of 24 kc/s at the Royal Observatory, Edinburgh, show a sudden decrease coinciding with the time of arrival of solar cosmic-ray particles in the dark hemisphere of the earth.

523.75 : 621.396.11 : 551.510.535 **2717**

Some Unusual Radio Observations made on 23 February 1956.—J. S. Belrose, M. H. Devenport & K. Weekes. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 281–286.) Records of sky-wave signals obtained at Cambridge, England, on frequencies 70–300 kc/s showed very strong absorption during the occurrence of the solar flare of this date; on 16 kc/s the main effect was a decrease of 7–8 km in the reflection height. On frequencies 1·5–8 Mc/s, at Upsala, almost complete absorption occurred from sunrise until the late afternoon.

55 : 621.396.934 **2718**

Symposium on the U.S. Earth Satellite Program—Vanguard of Outer Space.—(*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 741–767.) The text is given of seven papers presented at a symposium held in New York in March 1956, dealing with various aspects of the U.S.A. plans for launching earth satellites during the International Geophysical Year, 1957–1958.

550.384 **2719**

The Crust as the Possible Seat of Earth's Magnetism.—J. S. Chatterjee. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 233–239.) Magnetic material in the earth's crust, to a depth of 20 km, will be highly permeable as a result of temperature and pressure conditions. Interaction between solar corpuscular streams and a very weak initial magnetic field in the crust will magnetize it to saturation; the estimated magnetic moment of the shell agrees with the observed magnetic moment of the earth.

550.385.24 : 523.746.5 **2720**

Long-Period Variations in Geomagnetic Activity.—E. J. Chernosky. (*Trans. Amer. geophys. Union*, Aug. 1955, Vol. 36, No. 4, pp. 591–595.) Analysis of data shows that correlation between the sunspot number R and the magnetic u figure is markedly improved by taking means for the 11-year sunspot-number cycle and for the 22-year sunspot-magnetism cycle in place of annual means.

551.510.53 : 534.22 **2721**

Theory of the Rocket-Grenade Method of determining Upper-Atmospheric Properties by Sound Propagation.—G. V. Groves. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 189–203.) Theory applicable to projected experiments is developed from earlier work (2046 of July); a knowledge of the composition of the atmosphere and of the velocity of the sound of the explosions is assumed.

551.510.535 **2722**

Electron Distribution in the Ionosphere.—G. A. M. King & C. H. Cummack. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 270–273.) Analysis of $h'f$ records by the method described earlier [117 of 1955 (King)] suggests that the ionosphere consists of three Chapman layers, E, F_1 and F_2, and that the temperature is uniform.

551.510.535 **2723**

Effective Tilts of the Ionosphere at Places about 1 000 km apart.—H. A. Whale. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 301–310.) Fuller account of work described previously (1978 of 1955).

551.510.535 **2724**

The Rates of Production and Loss of Electrons in the F Region of the Ionosphere.—J. A. Ratcliffe, E. R. Schmerling, C. S. G. K. Setty & J. O. Thomas. (*Phil. Trans. A*, 1st March 1956, Vol. 248, No. 956, pp. 621–642.) From the results of Schmerling & Thomas (2726 below) the rates of production and loss of electrons in the region are deduced. Bradbury's theory of the formation of the F layers (1757 and 2184 of 1938) is shown to be self-consistent; it gives a scale height of 45 km for the ionizable constituent of the atmosphere between 180 and 350 km. This result agrees better with the atmospheric R model deduced by Bates from rocket experiments (*Rocket Exploration of the Upper Atmosphere*, 1954, pp. 347–356) than with the G model deduced from experiments made on the ground. Limits are established for the movements caused by electron diffusion under gravity.

551.510.535 **2725**

The Formation of the Ionospheric Layers F_1 and F_2.—J. A. Ratcliffe. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 260–269.) It is shown that an electron loss coefficient varying with height in the manner suggested previously (2724 above) would explain the known facts about the splitting of the F layer and might also be a factor in determining the height of the peak of electron density in the F_2 layer.

551.510.535 **2726**

The Distribution of Electrons in the Undisturbed F_2 Layer of the Ionosphere.—E. R. Schmerling & J. O. Thomas. (*Phil. Trans. A*, 1st March 1956, Vol. 248, No. 956, pp. 609–620.) The variation of electron density with height is deduced from $h'(f)$ records obtained at Watheroo, Huancayo and Slough, and the form of the typical F layer for magnetically quiet days is described in a series of curves; detailed tabulated results are available at the Cavendish Laboratory, Cambridge, England.

551.510.535 **2727**

Processes controlling Ionization Distribution in the F_2 Region of the Ionosphere.—D. F. Martyn. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 161–165.) Rocket measurements at heights approaching 200 km suggest that the atmospheric density in the F_2 region may be some 30 times less than previously deduced from radio experiments. If the new value were correct, diffusion of F_2 ionization under the forces of gravity and of its own pressure gradient would be likely to affect the shape and height of the region notably. An investigation was made of the possible effects of diffusion processes at such levels. The results indicate that a region with arbitrary height distribution of ionization will by diffusion assume the form of a Chapman region after a time which, for F_2 levels, is a few hours if the radio determinations of density are correct, but only a few minutes if the rocket determinations are correct. It is suggested that there must be a systematic error in the rocket observations.

551.510.535 **2728**

Observations and Analysis of Ionospheric Drift.—D. G. Yerg. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 247–259.) Spaced-receiver fading observations made at Puerto Rico during 1954–1955 on 2·33 and 4·57 Mc/s indicate average drift speeds of 19 m/s and 12 m/s respectively. The 2·33-Mc/s data are thought to

apply to the E layer, and the 4·57-Mc/s data to the F_1 layer. Owing to random changes, the method of similar fades is less reliable than the correlation method of evaluation.

551.510.535 **2729**

Automatic Recording of Ionospheric Characteristics.—K. Bibl. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, p. 295.) Following the proposals of Nakata et al. (2937 of 1954) a device is proposed which gives a direct record of m.u.f.

551.510.535 **2730**

Ionospheric Recorders and Sporadic E.—J. A. Thomas, A. C. Svenson & H. E. Brown. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 159–161.) Brief report of tests made at Brisbane, disproving the statement, which has been made by various workers, that the observed frequency characteristics of the E_s region vary rapidly with the overall sensitivity of the recording $P'f$ equipment.

551.510.535 : 523.16 : 550.385 **2731**

Spread F-Layer Echoes and Radio-Star Scintillation.—R. W. Wright, J. R. Koster & N. J. Skinner. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 240–246.) Correlation is noted between observations of radio-star scintillations at one station in equatorial W. Africa and of spread F layers at another, 510 km distant. Disturbed magnetic conditions, in winter, cause decreased F-layer spread.

551.510.535 : 523.78 **2732**

Ionospheric Observations during the Solar Eclipse of June 20, 1955.—A. K. Saha, S. Ray, S. Datta & R. K. Mitra. (*Sci. & Cult.*, Feb. 1956, Vol. 21, No. 8, pp. 475–477.) Observations made at Haringhata, 28 miles N.E. of Calcutta, are reported. The recorder used provided a frequency sweep from 1 to 13 Mc/s in 1 min 55 sec. The observed variation of f_0E shows that the disappearance and reappearance of the ionizing radiation source for the E layer was not symmetrical with respect to the time of the eclipse maximum. The ionization of the F_1 layer also showed a marked drop during the eclipse. An observed drop in the ionization of the F_2 layer may or may not have been an eclipse effect.

551.510.535 : 525.624 **2733**

Lunar Variations in the Ionosphere.—R. A. Duncan. (*Aust. J. Phys.*, March 1956, Vol. 9, No. 1, pp. 112–132.) The global pattern of the observed lunar variations of the height and electron density of the F_2 region is summarized, new analyses being presented for Canberra (f_0F_2), Brisbane ($h'F_2$) and Washington ($h'F_2$ and f_0F_2). The height variation has an amplitude of 1–3 km; maximum height occurs at 06 lunar hours at moderate latitudes and at 09 lunar hours at the geomagnetic equator. The variation of f_0F_2 has an amplitude of 2–4%; the maximum occurs at about 09 lunar hours at moderate geomagnetic latitudes and at 04 lunar hours near the geomagnetic equator. Theory is developed on the basis of a current system at a height of about 100 km. The tidal winds needed to drive the current, the potential distribution in the dynamo layer, and the resulting periodic vertical drifts of ionization in the higher layers are calculated. The lunar variations in f_0F_2 are calculated taking into account probable height variations of recombination coefficient and ionization production rate; the results are in good agreement with observations. It is concluded that the amplitude of the lunar tidal wind near the E layer is about 45 times greater than that on the ground.

551.510.535 : 551.557 **2734**

Influence of Variable Flow of Positive Solar Particles on the Wind in the Ionosphere.—V. V. Shuleikin & L. A. Korneva. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1956, Vol. 107, No. 1, pp. 59–62. In Russian.) Qualitative results of a calculation of the interaction of electrodynamic and hydrodynamic forces in the ionosphere, at a height where the two forces are of the same order of magnitude, indicate a distribution of wind velocity and direction (fig. 2a) similar to that observed by Hoffmeister (1932 of 1949) and shown in fig. 2b. Fig. 1 shows the variation of the E–W and N–S components and of the resultant of the wind velocity over a 27-day period.

531.510.535 : 621.396.11 **2735**

Oblique Transmission by the Meteoric E-Layer.—Naismith. (See 2871.)

551.576/.578 : 621.396.969.36 **2736**

The Nature and Detectability of Clouds and Precipitation as determined by 1·25-cm Radar.—Plank, Atlas & Paulsen. (See 2749.)

551.59 : 538.566.029.6 : 523.72 **2737**

Measurement of Atmospheric Absorption on 9 350 Mc/s, using Solar R.F. Radiation.—P. André, I. Kazes & J. L. Steinberg. (*C. R. Acad. Sci., Paris*, 23rd April 1956, Vol. 242, No. 17, pp. 2099–2101.) Measurements were made at various times of day, using a radiotelescope described previously [1636 of 1955 (Kazes & Steinberg)]. Only a part of the attenuation observed during sunset can be attributed to absorption by oxygen and water vapour; the remainder, about 35%, is so far unexplained.

551.593 **2738**

The Height of Emission of the 5577 Line of the Air-Glow as observed on the Jungfraujoch.—H. Elsässer & H. Siedentopf. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 222–232. In German.) A mean altitude of 90 ± 10 km is deduced.

551.594.5 : 621.396.11.029.62 **2739**

A Theory of Scattering by Nonisotropic Irregularities with Application to Radar Reflections from the Aurora.—H. G. Booker. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, pp. 204–221.) The existence and aspect sensitivity of auroral v.h.f. echoes can be explained as back scatter from nonisotropic columns of ionization parallel to the earth's magnetic field, of length about 40 m and diameter 1 m, caused by turbulence in an E region having a maximum electron density about 100 times the normal value; but the theory fails to explain the rapid fading rates associated with auroral echoes.

551.594.6 : 621.396.933 **2740**

Low-Frequency Atmospheric Noise Levels in Southern and Central Africa.—D. Hogg. (*Trans. S. Afr. Inst. elect. Engrs*, Dec. 1955, Vol. 46, Part 12, pp. 341–348.) Detailed report of measurements made to determine the interfering effect of atmospherics on radio navigation aids. Results are presented graphically and discussed with reference to local thunder conditions. See also 2305 of 1955.

523.5 : 061.3 **2741**

Meteors. [Book review]—T. R. Kaiser (Ed.). Publishers : Pergamon Press, London and New York, 1955, 204 pp., 55s. (*J. Franklin Inst.*, Feb. 1956, Vol. 261, No. 2, p. 275.) The text is given of the papers presented at the symposium reported previously (1016 of 1955).

LOCATION AND AIDS TO NAVIGATION

534.88-14 **2742**

Underwater Echo-Ranging.—D. G. Tucker. (*J. Brit. Instn Radio Engrs*, May 1956, Vol. 16, No. 5, pp. 243–269.) A review covering basic principles, engineering aspects, and various applications. 66 references.

621.396.93 **2743**

D.F. Plotting Aid.—H. G. Hopkins. (*Wireless Engr*, July 1956, Vol. 33, No. 7, pp. 173–175.) The simple aid described is in the form of a transparent graticule which is placed on the map over the most probable position of the transmitter to facilitate the determination of the area within which the transmitter lies with a given probability.

621.396.93 : 621.396.11.029.55 **2744**

An Automatic Direction Finder for recording Rapid Fluctuations of the Bearing of Short Radio Waves.—H. A. Whale & W. J. Ross. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 311–320.) The signals in two pairs of aerials placed at the corners of a rectangle 10 m × 5 m are combined so that a required 90° phase shift is automatically maintained at all frequencies up to about 17 Mc/s; sense is determined manually. The accuracy of the system is discussed; the effective aperture must be small if it is to follow bearing fluctuations when there is an appreciable spread of the component waves in the incoming signal.

621.396.933 : 551.594.6 **2745**

Low-Frequency Atmospheric Noise Levels in Southern and Central Africa.—Hogg. (See 2740.)

621.396.969.13 **2746**

The Radar Measurement of Low Angles of Elevation.—J. S. Hey & S. J. Parsons. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 321–328.) "The errors which occur in the measurement of low angles of elevation by centimetric radar on a flat ground site are estimated theoretically and compared with experimental measurements. It is demonstrated that a very considerable improvement in angular accuracy is obtained by erecting a screen to intercept the ground-reflected wave. The diffraction effects due to the screen are discussed."

621.396.969.3 **2747**

The Effect of A.G.C. on Radar Tracking Noise.—R. H. Delano & I. Pfeffer. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 801–810.) Low-frequency components of the noise arising from the fluctuating properties of the target echo are enhanced by the a.g.c. action. This disadvantage could be avoided by slowing down the a.g.c. response, but such a solution might be unsatisfactory for other reasons, e.g. in the case of a radar system closing rapidly on a target. The solution presented is to place a nonlinear filter in the a.g.c. path, providing a fast response to rising signals and a slow response to decaying signals.

621.396.969.35 **2748**

Multipath Phase Errors in C.W.-F.M. Tracking Systems.—T. E. Sollenberger. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 185–192.) Errors in missile-tracking systems due to reflections from the ground and from neighbouring objects are discussed. Use of frequency modulation permits discrimination against the relatively weak interfering signals. The phase error can be reduced indefinitely by increasing the bandwidth used.

621.396.969.36 : 551.576/.578 **2749**

The Nature and Detectability of Clouds and Precipitation as determined by 1·25-cm Radar.—V. G. Plank, D. Atlas & W. H. Paulsen. (*J. Met.*, Aug. 1955, Vol. 12, No. 4, pp. 358–378.) Results are presented of a survey of the frequency of occurrence of various cloud types from their echo characteristics. With most types, temperature is the most important factor affecting detectability; the presence of ice crystals increases detectability. The 1·25-cm radar equipment used would detect only about 15% of clouds of common types at ranges up to 1 mile. The characteristic features of stratiform precipitation are discussed.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 : 621.311.6 **2750**

Stabilized Power Supply for an Ionization Gauge for Industrial Use.—R. F. Henry. (*Le Vide*, Jan./Feb. 1956, Vol. 11, No. 61, pp. 28–33.) Neon stabilizers are used for the (positive) grid potential. A triode stabilizing circuit in the filament supply compensates for variations in the grid current of the gauge.

533.5 **2751**

Some Particular Features of the Ionization Method of producing a Very High Vacuum.—N. D. Morgulis. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1667–1670.) Experiments made to investigate the nature of the method are briefly reported and a number of practical suggestions are offered.

533.56 **2752**

Experimental Study of a Rotary Molecular Pump.—G. Mongodin & F. Prevot. (*Le Vide*, Jan./Feb. 1956, Vol. 11, No. 61, pp. 3–13.)

535.215 **2753**

Spectral Distribution of Photoconductivity.—H. B. DeVore. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 86–91.) "A theoretical analysis of the shape of photoconductivity spectral distribution curves is presented, based upon the effects of surface and volume recombination of the charge carriers liberated by the light. Representative curves of photoconductivity *vs* absorption are computed and compared with experimental observations. As an application of this analysis, experimental data for antimony sulfide are compared with a theoretical curve, and the difference is found to be resolvable into two bands representing nonphotoconductive transitions."

535.215 : 537.311.33 : 546.289 **2754**

The Energy Distribution of Electrons in the External Photoeffect of Germanium containing Impurities.—A. N. Arsen'eva-Geil'. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1544–1546.) Experimental V/I characteristics are plotted indicating that photoelectrons are emitted from two energy regions. When the Ge layer is heated to 60°–100°C, an irreversible change in the contact-potential difference between the collector and the emitter takes place, and the number of photo-electrons is considerably increased.

535.215 : 537.311.33 : 546.482.21 **2755**

Comparison of Surface-Excited and Volume-Excited Photoconduction in Cadmium Sulfide Crystals.—R. H. Bube. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1668–1676.) Measurements have been made of the spectral response, the variation of the

photocurrent with illumination intensity, the quenching effect of infrared radiation, the decay time of the photocurrent, and the effect of thermal stimulation. The results can be largely explained by assuming that the surface is inherently less sensitive than the interior of the crystals, the surface sensitivity being highly dependent on the surrounding atmosphere.

535.215 : 537.311.33 : 546.482.21 : 537.312.8 **2756**

Change of Photocurrent of CdS Single Crystal in a Magnetic Field.—S. Tanaka, T. Masumi & S. Iijima. (*J. phys. Soc. Japan*, Jan. 1956, Vol. 11, No. 1, pp. 90–91.) Experiments indicate that the photocurrent increases or decreases, depending on the direction of the magnetic field.

535.215 : 546.57 **2757**

Photoemission from Silver into Sodium Chloride, Thallium Chloride and Thallium Bromide.—W. J. Turner. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1653–1660.) Experiments yielding negative results are reported.

535.37 : 546.472.21 **2758**

Investigation of the Origin of Electron Localization Levels in Zinc Sulphide [ZnS-Cu] **Phosphors.**—N. V. Zhukova. (*Zh. eksp. teor. Phys.*, Nov. 1955, Vol. 29, No. 5(11), pp. 680–692.) Three thermoluminescence intensity maxima were observed; these occured at (*a*) − 120°C, due to excess Zn in the ZnS lattice, at (*b*) − 60°C, and at (*c*) + 20°C, due to Cu luminescence centres. The shape of the curve over different temperature ranges is related to the composition. The quenching effect of Fe, Ni and Co was investigated at temperatures from − 180° to + 60°C. Results are presented graphically.

535.37 : 546.472.21 **2759**

Conductivity Measurements and Spectrographic and X-Ray Investigations on Zinc Sulphide Crystals.—J. Krumbiegel & K. H. Jost. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 526–529.) The conductivity measurements indicate that the photosensitivity maximum occurs at a wavelength of 3 520 Å. The spectrographic investigation indicates that crystals with different-coloured luminescence do not necessarily contain different impurities.

535.376 **2760**

Contribution to the Study of Quenching and Sensitizing Effects of Electric Fields.—H. E. Gumlich. (*J. Phys. Radium*, Feb. 1956, Vol. 17, No. 2, pp. 117–121.) The luminescence of ZnS–CdS mixtures activated by Mn and excited by ultraviolet or X rays was investigated experimentally. With ultraviolet excitation an applied field has a quenching effect, with X-ray excitation it produces permanent enhancement of the luminescence. See also 2081 of July (Destriau et al.).

535.376 **2761**

The Temperature Dependence of Brightness Waves in Electroluminescence.—D. Hahn & F. W. Seemann. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 586–587.) A number of phosphors have been studied. Oscillograms are reproduced showing the change in the form of the brightness waves of two phosphors at temperatures between − 95° and + 110°C in a 500-c/s field.

535.376 : [546.472.21 + 546.48.47.221 **2762**

Spectral Energy Distribution Curves of ZnS:Ag and ZnCdS:Ag after Thermal Vacuum Treatment.—C. H. Bachman, M. L. Sawner & W. Allen. (*J. electrochem. Soc.*, Feb. 1956, Vol. 103, No. 2, pp. 117–122.) Phosphor screens of thickness comparable to that used in c.r. tubes were maintained at temperatures between 300° and 800°C for 5–30 min in vacuum; measurements were then made of the spectral energy distribution under bombardment by a diffuse 1 000-V electron beam. The heating produces both general reductions and spectral redistributions of emission. The results are discussed in relation to the ion-burn effect in c.r. tubes.

535.376 : 546.472.21 **2763**

Electrophotoluminescence Effects.—F. Matossi & S. Nudelman. (*J. electrochem. Soc.*, Feb. 1956, Vol. 103, No. 2, pp. 122–127.) A study is reported of the frequency and field-strength dependence of the intensity quenching and the intensity ripple occurring on application of an electric field to a phosphor; 28 different ultraviolet-excited ZnS phosphors of cubic and hexagonal structure were investigated.

535.376 : 546.472.21 **2764**

Electroluminescence in Zinc Sulfide.—W. A. Thornton. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 38–46.) Simple theory based on single-level electron trapping and a field-controlled thermal release process is developed to explain the observed dependence of the electroluminescence waveform and the integrated light output on voltage, frequency and temperature.

537.226/.228 : 546.431.824-31 **2765**

Role of Domain Processes in Polycrystalline Barium Titanate.—M. McQuarrie. (*J. Amer. ceram. Soc.*, 1st Feb. 1956, Vol. 39, No. 2, pp. 54–59.) Discussion of results obtained by various workers indicates that while the high initial dielectric constant of polycrystalline $BaTiO_3$, and possibly also the frequency variation of the initial dielectric constant, can be accounted for without making assumptions regarding domain-wall motion, effects associated with the 'poling' and aging processes can be explained more satisfactorily in terms of movements of both 90° and 180° walls.

537.226/.227 : 546.431.824-31 **2766**

Retarded Polarization Phenomena in $BaTiO_3$ Crystals.—H. H. Wieder. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 413–416.) An investigation was made of the relation between the applied electric field and the resulting polarization of *c*-domain $BaTiO_3$ crystals in the tetragonal crystal phase for field strengths < 1 kV/cm. The results indicate that the processes involved are the same as for greater field strengths. No threshold value of field strength was found for the propagation of antiparallel nuclei.

537.226.31 **2767**

Dielectric Losses in Ionic Dielectrics in Strong Electric Fields.—L. E. Gurévich & V. N. Gribov. (*Zh. eksp. teor. Phys.*, Nov. 1955, Vol. 29, No. 5(11), pp. 629–636.) Dielectrics in which the ions in the crystal lattice exist in two nearly equal energy states are considered theoretically. Polarization, low-frequency and high-frequency losses are calculated.

537.226.31 : 549.514.51 **2768**

Electric Polarizability of Colour Centres in Quartz Crystals and Glasses.—J. Volger & J. M. Stevels. (*Philips Res. Rep.*, Feb. 1956, Vol. 11, No. 1, pp. 79–80.) Relaxation losses induced in clear crystals by irradiation at low temperatures are attributed to orientational polarizability of colour centres generated by impurities, such that transitions occur between equivalent positions of trapped electrons or holes. The effect has not been observed in glasses.

537.226.8 **2769**

Effects of Pressure on the Complex Dielectric Constant of Liquids.—P. Caillon & E. Groubert. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1855–1856.) Measurements on chlorodiphenyl at a frequency of 127 kc/s indicate that the characteristic variation of dielectric constant with pressure at normal temperature is similar to that with temperature at normal pressure.

537.227/228.1 + 621.372.412 + 621.373.421.13 **2770**

Papers presented at the 2nd Conference on Piezoelectricity (Moscow, 26th–29th April 1955).—(*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Feb. 1956, Vol. 20, No. 2, pp. 163–272. In Russian.) The following 15 papers are collected in this issue:—

New Ferroelectrics and Antiferroelectrics of the Oxygen-Octahedral Type.—G. A. Smolenski (pp. 163–177).

X-Ray Structural Investigation of Solid Solutions of Ferroelectrics with Perovskite-Type Structure.—Yu. N. Venevtsev & G. S. Zhdanov (pp. 178–184).

Nonlinear Properties of Ferroelectrics.—T. N. Verbitskaya (pp. 185–194).

Stability of the Piezoelectric Effect in Polycrystalline Barium Titanate.—I. P. Kozlobaev (pp. 195–198).

Effect of Pressure on the Dielectric Properties of Ferroelectric Ceramics.—I. A. Izhak (pp. 199–205).

Fusion of Barium Titanate by Conduction Currents.—N. S. Novosil'tsev, O. I. Prokopalo & A. F. Yatsenko (pp. 206–210).

Some Physical Properties of Ferroelectric-Salt Crystals exposed to Radioactive Irradiation.—I. S. Zheludev & V. A. Yurin (pp. 211–214).

Some Physical Properties of Ferroelectric-Salt Crystals.—I. Ya. Eisner (pp. 215–218).

Investigation of New Piezoelectric Crystals.—V. A. Koptsik (pp. 219–225).

Piezoelectric Properties of Wood and Cellulose Materials.—V. A. Bazhenov (pp. 226–230).

Thermal Mechanical Oscillations (Fluctuations) of Piezoelectric Crystals.—K. V. Goncharov & V. A. Krasil'nikov (pp. 231–236).

New Quartz Parameters and Engineering Method of Quartz Oscillator Design.—E. I. Kamenski (pp. 237–250).

Parasitic Oscillations of Piezoelectric Plates with Fundamental Longitudinal Oscillations.—E. G. Bronnikova (pp. 251–260).

Theory of the Compound Piezoelectric Vibrator.—V. A. Solov'ev & I. G. Mikhailov (pp. 261–267).

Piezoelectric Resonators with Crystals having Structural Defects.—M. I. Yaroslavski (pp. 268–272).

537.227 **2771**

X-Ray and Neutron Diffraction Study of Ferroelectric $PbTiO_3$.—G. Shirane, R. Pepinsky & B. C. Frazer. (*Acta cryst.*, 10th Feb. 1956, Vol. 9, Part 2, pp. 131–140.) Detailed account of work noted previously from shorter paper (2312 of 1955).

537.227 **2772**

Guanidine Vanadium Sulfate Hexahydrate: a New Ferroelectric Material.—J. P. Remeika & W. J. Merz. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, p. 295.) A brief note on the preparation and properties of this material; the shape of the 60-c/s hysteresis loop is more nearly rectangular than that of the corresponding compound with aluminium in place of the vanadium [2415 of August (Holden et al.)].

537.227 : [546.431.824-31 + 546.824-3] : 548.0 **2773**

An Explanation of the Structures of Hexagonal Barium Titanate and Titanium Dioxide.—P. Vousden. (*Acta cryst.*, 10th Feb. 1956, Vol. 9, Part 2, pp. 141–142.)

537.227 : 547.476.3 **2774**

On Ferroelectric Barkhausen Pulses of Rochelle Salt.—R. Abe. (*J. phys. Soc. Japan*, Feb. 1956, Vol. 11, No. 2, pp. 104–111.) Experiments are described in which Barkhausen pulses were observed on applying an electric field to the crystal. The volumes whose polarization reversal corresponds to single pulses are estimated to be of the order of 10^{-9} cm³. From the field-strength threshold values it is inferred that the pulses occur when a domain wall passes across a hollow in a crystal.

537.311.33 **2775**

The Voltage/Current Characteristic of the *n-p* Junction for a Weak Signal.—E. I. Rashba. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1663–1667.) Published literature on the subject is reviewed and inaccuracies in a paper by Shockley (379 of 1950) are pointed out. A statistical system of equations (1) determining the dynamic characteristic of a *p-n* junction is quoted and applied to the case of small alternating voltages, of the order of a few hundred mV, superimposed on a constant reverse bias. Methods are indicated for an approximate solution of these equations for various conditions, and formulae are derived for determining the capacitance of the junction.

537.311.33 **2776**

Theoretical Study of the Current/Voltage Characteristic of a Semiconductor *p-i-p* Structure, taking Account of Ionization of the Medium due to Carriers.—A. Leblond. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1856–1859.) In the structure considered, the major part of an applied voltage is across the intrinsic middle region, since the adjacent *p* regions have much higher conductivity. Theory is developed affording an explanation of the negative region of the I/V characteristic which has been observed experimentally; this negative characteristic is a consequence of ionization which occurs in the vicinity of the two junctions, where very strong fields develop at high current values.

537.311.33 **2777**

Diffusion Effects in Drift-Mobility Measurements in Semiconductors.—J. P. McKelvey. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 341–343.) A simple method of measurement, using low-strength steady fields between the emitter and collector, gives results of satisfactory accuracy if an appropriate correction is made for diffusion effects.

537.311.33 : 061.3 **2778**

Research in Semiconductors: Symposium at Ottawa.—T. H. K. Barron. (*Nature, Lond.*, 5th May 1956, Vol. 177, No. 4514, p. 833.) Brief report of a symposium held in February 1956.

537.311.33 : 535.215 **2779**

The Photoelectric Properties of some Compounds with Zinc-Blende Structure.—N. A. Goryunova, V. S. Grigor'eva, B. M. Konovalenko & S. M. Ryvkin. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1675–1682.) Experiments were conducted with compounds of indium and gallium having the same crystal structure as zinc blende. All these materials are semiconductors and sensitive to light. Spectral characteristics are shown, together with tables of experimental data.

537.311.33 : 535.215 : 538.63 **2780**

Theory of the Photomagnetoelectric [PME] Effect in Semiconductors.—W. van Roosbroeck. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1713–1725.) "Through an ambipolar treatment, the underlying general theory for current carrier transport with

magnetic field, which can provide . . . unrestricted results for the Hall, Suhl, and magnetic rectifier effects, is first developed. The PME effect is considered in detail for the infinite slab with strongly absorbed steady radiation on one surface and parallel, steady, uniform magnetic field. Small Hall angles and constant surface recombination velocities and lifetime are assumed. Small-signal theory is given as well as nonlinear theory for arbitrary light intensity. The latter provides methods for determining lifetime that require only negligible dark-surface concentration of added carriers, as well as a method for determining surface recombination velocity; curves for these are given for germanium."

537.311.33 : 541.57 **2781**

Chemical Bond in Semiconductors.—E. Mooser & W. B. Pearson. (*Phys. Rev.*, 1st March 1956, Vol. 101, No. 5, pp. 1608–1609.) Semiconductivity results from the existence in a solid of essentially covalent bonds, with filled s and p sub-shells occurring in at least one of any two atoms connected by a bond. This property allows a sharp distinction to be made between semiconductors and metals. A simple rule is given for predicting whether a given compound will be semiconducting from a knowledge of the stoichiometric formula and the valencies of the constituent atoms. The formation of a continuous network of bonds distinguishes semiconductors from molecular crystals.

537.311.33 : 546.23 **2782**

Conductivity Measurements on Highly Purified Selenium.—F. Eckart. (*Ann. Phys., Lpz.*, 1st Feb. 1956, Vol. 17, Nos. 2/3, pp. 84–93.) A continuation of earlier work (3582 of 1954) is reported. The activation energy, determined in the temperature range 18°–40°C, was 1·2–1·6 eV for a specimen remelted several times in vacuum. After heat treatment in air the activation energy dropped to 0·14–0·19 eV and the conductivity increased by a factor of 10^6.

537.311.33 : 546.26 **2783**

Thermoelectric Power, Electrical Resistance, and Crystalline Structure of Carbons.—E. E. Loebner. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 46–57.) Report of measurements on soft and hard carbons; the influence of heat-treatment temperature was investigated.

537.311.33 : 546.26-1 **2784**

Electrical and Optical Properties of a Semiconducting Diamond.—I. G. Austin & R. Wolfe. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 329–338.) The resistivity, Hall coefficient and infrared absorption spectrum of a type-IIb diamond have been investigated over a wide range of temperatures. The material behaves like a normal p-type semiconductor. Photoconductivity was detected at — 155°C over the wavelength range 0·9–3·6 μ. A model energy-band structure is proposed.

537.311.33 : 546.26-1 **2785**

Electrical Measurements on Type-IIb Diamonds.—H. B. Dyer & P. T. Wedepohl. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 410–412.) The rectification characteristics, resistance linearity, temperature dependence of conductivity and Hall coefficient of type-IIb diamonds have been determined. Conductivity at room temperature is found to be related to the strength of infrared absorption bands.

537.311.33 : 546.26-1 **2786**

Some Physical Consequences of Elementary Defects in Diamonds.—F. C. Champion. (*Proc. roy. Soc. A*, 6th March 1956, Vol. 234, No. 1199, pp. 541–556.) Using the concept of the defect bond, a qualitative theory is developed of the physical properties of pure diamond, including the electrical properties and the electronic energy levels.

537.311.33 : [546.28 + 546.289 **2787**

Influence of Holes and Electrons on the Solubility of Lithium in Boron-Doped Silicon.—H. Reiss & C. S. Fuller. (*J. Metals, N.Y.*, Feb. 1956, Vol. 8, No. 2, pp. 276–282.) Fuller details are given of work reported previously (2011 of 1955). Experimental results support the theoretical prediction that increase of acceptor (boron) content leads to increased solubility of donor (lithium) in the boron-doped Si; the expected temperature variation is observed. Qualitative results for Ge indicate that doping with a donor decreases the solubility of another donor.

537.311.33 : 546.28 **2788**

Spiral Etch Pits in Silicon.—W. Bardsley & B. W. Straughan. (*J. Electronics*, March 1956, Vol. 1, No. 5, pp. 561–562.)

537.311.33 : 546.28 **2789**

Radiation resulting from Recombination of Holes and Electrons in Silicon.—J. R. Haynes & W. C. Westphal. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1676–1678.) Recombination radiation produced following application of current pulses to Si p-n junctions has been investigated using a PbS cell. The results indicate that the radiation at room temperature is a property of the intrinsic material; additional radiation observed at 77°K is associated with the presence of impurities.

537.311.33 : 546.28 **2790**

Drift and Conductivity Mobility in Silicon.—G. W. Ludwig & R. L. Watters. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1699–1701.) The drift mobility of minority carriers has been measured at temperatures between 120° and 400°K for p-type specimens and between 78° and 400°K for n-type specimens, using a pulsed-field method. Formulae are derived for the temperature variation of the mobilities; the validity of these formulae is confirmed by the results of conductivity measurements over the same temperature range.

537.311.33 : 546.281.26 **2791**

Energy-Band Structure of the Carborundum SiC Crystal.—S. Kobayasi. (*J. phys. Soc. Japan*, Feb. 1956, Vol. 11, No. 2, pp. 175–176.) Brief preliminary report of computations.

537.311.33 : 546.289 **2792**

On the Impurity Conduction in Germanium.—Y. Kanai & R. Nii. (*J. phys. Soc. Japan*, Jan. 1956, Vol. 11, No. 1, pp. 83–84.) The work of Hung & Gliessmann (1696 of 1955) and of Fritzsche & Lark-Horovitz (2018 of 1955) is confirmed by an investigation of Ni-doped Ge, in which impurity-type conduction is shown to occur at higher temperatures than with normal Ge.

537.311.33 : 546.289 **2793**

Thermally Induced Acceptors in Germanium.—R. A. Logan. (*Phys. Rev.*, 1st March 1956, Vol. 101, No. 5, pp. 1455–1459.) Previous investigations (e.g. 170 of 1954) are extended. Results indicate that acceptor centres formed by rapid quenching from high temperatures are either vacant lattice sites or a chemical impurity with atomic radius smaller than that of Ge. The annealing process depends on both the density of dislocations and the concentration of Cu; no mechanism has yet been proposed capable of explaining the observed characteristics of the annealing process.

537.311.33 : 546.289 **2794**

The Effect of Heat Treatment on the Lifetime of Minority Current Carriers in Germanium (the Kinetics of the Formation of Defects during Heat Treatment).—T. V. Mashovets & S. M. Ryvkin. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1530–1543.) If Ge is heated to relatively low temperatures (400°–550°C) the lifetime of the minority carriers is decreased when the temperature and duration of heating are increased. This is explained by the formation of defects which act as recombination centres. From a study of the process of appearance of the defects, data have been obtained on their energy structure. For the temperature range investigated, this process is different from that involved in the formation of thermal defects in Ge at higher temperatures.

537.311.33 : 546.289 : 537.533 **2795**

Temperature Variations of the Work Function of *n*-Type and *p*-Type Germanium.—A. R. Shul'man & A. N. Pisarevski. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 9, pp. 1547–1555.) Results of an experimental investigation indicate that there is a definite temperature dependence of the work function and of the position of the chemical potential level and that in each case it is different for *n*-type and *p*-type Ge. The experiments are described, and a number of curves are plotted. A theoretical interpretation of the results is given.

537.311.33 : 546.289 : 538.63 **2796**

The Resistance Variation of Ge Single Crystals in a Magnetic Field at 10°–300°K.—G. Lautz & W. Ruppel. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 521–526.) Measurements of the variation of transverse resistance have been made on *p*- and *n*-type specimens in magnetic fields of strengths up to 24 kG. The results are not in agreement with theories based on semiconductor isotropy, such as that of Appel (450 of 1955); measured values are much higher than calculated ones. For a particularly pure *n*-type specimen at 11°K a variation of 1 200% was observed without any indication of saturation. The mechanism giving rise to this variation is not yet understood, but quantization of the electron paths at low temperatures may be the explanation.

537.311.33 : 546.289.05 **2797**

Electrolytic Stream Etching of Germanium.—M. V. Sullivan & J. H. Eigler. (*J. electrochem. Soc.*, Feb. 1956, Vol. 103, No. 2, pp. 132–134.) The stream of 0·1% KOH solution used for the etching is restricted to a junction area by means of a special jig. The technique and results obtained are described.

537.311.33 : 546.3-1 : 541.5 **2798**

On the Valence and Atomic Size of Silicon, Germanium, Arsenic, Antimony, and Bismuth in Alloys.—L. Pauling & P. Pauling. (*Acta cryst.*, 10th Feb. 1956, Vol. 9, Part 2, pp. 127–130.)

537.311.33 : 546.461-31 **2799**

The Mechanism of Growth of Cuprous Oxide Crystals at High Temperature.—A. I. Andrievski & M. T. Mishchenko. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1956, Vol. 107, No. 1, pp. 81–83. In Russian.) Photographs of Cu_2O surfaces after heating at a temperature of 1 020°C for 90 and 157 hours are presented and discussed.

537.311.33 : 546.471.95 **2800**

The Semiconductor Properties of $ZnAs_2$.—C. Fritzsche. (*Ann. Phys., Lpz.*, 1st Feb. 1956, Vol. 17, Nos. 2/3, pp. 94–101.) The preparation of $ZnAs_2$ and similar compounds is briefly described and the results of conductivity and rectification measurements are presented graphically. The highest observed forward/reverse current ratio in a $ZnAs_2$ point-contact diode was 3 000 : 1 at 3 V. This ratio depends on the orientation of the crystal, the best results being obtained when the current flow is in the direction of the highest resistance.

537.311.33 : 546.57.241.1 **2801**

Electrical and Optical Properties of Silver Telluride Ag_2Te.—J. Appel. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 530–541.) An extensive experimental investigation of the semiconductor properties of Ag_2Te is reported. A phase transition occurs at 150°C, associated with marked variations of the electrical properties. From the temperature variation of the properties of stoichiometric *n*-type specimens a covalent metallic bond is inferred for the low-temperature (β) phase. Impurities such as Ge, Sn and Sb have a strong effect on carrier concentration and mobility. Temperature variation of the properties in the high-temperature (α) phase indicates that Ag ions as well as electrons participate in the conduction. Discussion of the mobility values in the light of Howarth & Sondheimer's theory (381 of 1954) leads to a value of 0·4 m for the apparent mass of the carriers. A value of 0·67 eV is obtained for the energy gap of the β phase from optical absorption measurements.

537.311.33 : 546.682.86 **2802**

Elastic Constants of Indium Antimonide.—L. H. DeVaux & F. A. Pizzarello. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, p. 85.) Values of the elastic constants derived from sound-velocity measurements are given.

537.311.33 : 546.682.86 **2803**

The Conductivity of Indium Antimonide at Low Temperature.—J. Bok. (*C. R. Acad. Sci., Paris*, 23rd April 1956, Vol. 242, No. 17, pp. 2114–2117.) Measurements were made of the electric field strength as a function of current strength at a temperature of 20°K using two specimens with different resistivities. In each case the curve obtained first rises in accordance with Ohm's law, then turns horizontal, and finally rises sharply again. The significance of this characteristic is discussed with reference to theory advanced by Conwell (3328 of 1953) in relation to Ge.

537.311.33 : 546.682.86 **2804**

Effects at High-Angle Grain Boundaries in Indium Antimonide.—I. M. Mackintosh. (*J. Electronics*, March 1956, Vol. 1, No. 5, pp. 554–558.) Experiments on *n*- and *p*-type filament specimens at room temperature and lower temperatures are reported.

537.311.33 : 546.682.86 **2805**

Low-Temperature Magnetoresistance Anomalies in Indium Antimonide.—I. M. Mackintosh. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 403–406.) The observation of Fritzsche & Lark-Horovitz (160 of January), that the magnetoresistive ratio of InSb becomes negative below about 8°K, may be explained by changes in the concentration of charge carriers which occur when the impurity levels supplying these carriers are split in a magnetic field, although serious quantitative discrepancies are found on attempting to verify the theory.

537.311.33 : 546.682.86 **2806**

Population Changes with Magnetic Field.—K. W. H. Stevens. (*Proc. phys. Soc.*, 1st March 1956, Vol. 69, No. 435B, pp. 406–407.) The relative change in the number of conduction electrons on application of a magnetic field is determined by a method alternative to that of Mackintosh (2805 above). The possibility of a reversal in the sign of the magnetoresistance at low temperature is confirmed.

537.311.33 : 546.682.86 : 535.215 **2807**

Recombination Radiation from InSb.—T. S. Moss & T. H. Hawkins. (*Phys. Rev.*, 1st March 1956, Vol. 101, No. 5, pp. 1609–1610.) Radiation produced by the recombination of optically produced excess carriers has been detected in the wavelength region near the absorption edge. From the magnitude of the effect it is deduced that the fraction of total recombinations which are radiative approaches 100%.

537.311.33 : 546.682.86.05 : 669.054 **2808**

Effect of Zone-Refining Variables on the Segregation of Impurities in Indium-Antimonide.—T. C. Harman. (*J. electrochem. Soc.*, Feb. 1956, Vol. 103, No. 2, pp. 128–132.) Zinc and tellurium can be removed from the indium used in the preparation of InSb by electrolytic refining and zone-refining, respectively. The compound is further purified by zone-refining.

537.311.33 : 548.1 **2809**

Junction Rectification as a Function of Crystal Orientation.—W. Kossel, E. Menzel & G. Naumann. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 590–592.) Experiments with junctions of Cu and Cu_2O single crystals are described and discussed. Forward current is greater and reverse current is smaller for an octahedral crystal surface than for a dodecahedral surface, and the forward/reverse current ratio is better for the octahedral surface.

537.311.33 : 669.046.54/.55 **2810**

Zone-Melting Processes for Pure Compounds AB with a Negligible Vapour Pressure.—J. van den Boomgaard. (*Philips Res. Rep.*, Feb. 1956, Vol. 11, No. 1, pp. 27–44.) Expressions are derived for deviations from the stoichiometric composition as a function of position along a rod of a binary semiconductor subjected to zone melting.

537.311.33.07 **2811**

Micromanipulators.—W. L. Bond. (*Bell Lab. Rec.*, March 1956, Vol. 34, No. 3, pp. 90–92.) An illustrated note on two devices for controlling and locating metal contacts on a semiconductor surface in research.

538.22 + 537.311.3 **2812**

Magnetic and Electrical Properties of Manganese Telluride.—E. Uchida, H. Kondoh & N. Fukuoka. (*J. phys. Soc. Japan*, Jan. 1956, Vol. 11, No. 1, pp. 27–32.) The temperature variation of susceptibility may be explained by assuming the presence of two phases corresponding to MnTe and $MnTe_2$, possessing different susceptibilities. The electrical properties show anomalies at the Néel point; at higher temperatures the material behaves as a semiconductor, at lower temperatures as a metal. A change in crystalline structure at about 130°C is indicated.

538.22 **2813**

Magnetic Properties of Nickel Telluride.—E. Uchida & H. Kondoh. (*J. phys. Soc. Japan*, Jan. 1956, Vol. 11, No. 1, pp. 21–27.) $NiTe_x$ is ferromagnetic in the range $0{\cdot}1 < x < 0{\cdot}65$. There is a transition at $x = 0{\cdot}33$ from a heterogeneous phase beginning at $x = 0$ to a homogeneous phase. In the range $0{\cdot}7 < x < 2{\cdot}0$ the material is paramagnetic, but its behaviour is anomalous at high temperatures.

538.22 **2814**

Condition for Resonance in a Nearly Compensated Ferrimagnetic.—K. F. Niessen. (*Philips Res. Rep.*, Feb. 1956, Vol. 11, No. 1, pp. 57–65.) The resonance condition is calculated for a ferrimagnetic with two sublattices having slightly different properties. The theory is applicable to an antiferromagnetic in whose sublattice a relatively small number of magnetic ions have been replaced by non-magnetic ones.

538.22 **2815**

Domain Walls in Antiferromagnets and the Weak Ferromagnetism of α-Fe_2O_3.—Y. Y. Li. (*Phys. Rev.* 1st March 1956, Vol. 101, No. 5, pp. 1450–1454.)

538.22 : 538.652 **2816**

Magnetostrictive Effects in an Antiferromagnetic Hematite Crystal.—H. M. A. Urquhart & J. E. Goldman. (*Phys. Rev.*, 1st March 1956, Vol. 101, No. 5, pp. 1443–1450.) "Magnetostrictive distortions in an antiferromagnetic natural single crystal of hematite have been studied in the region of the transition near − 25°C, where the antiferromagnetic axis spontaneously shifts its crystallographic direction by 90°. The magnetostriction is shown to be closely related to the parasitic magnetization and is interpreted in terms of the existence of domain walls separating antiferromagnetic domains."

538.221 **2817**

Ferromagnetic Relaxation and Gyromagnetic Anomalies in Metals.—C. Kittel & A. H. Mitchell. (*Phys. Rev.*, 1st March 1956, Vol. 101, No. 5, pp. 1611–1612.) A new mechanism is proposed which may contribute to relaxation in all ferromagnetic metals and which appears to account for both the apparent frequency dependence of the observed g values and the apparent inaccuracy of the theoretical connection between microwave and magnetomechanical studies.

538.221 : 538.569.4 **2818**

Ferromagnetic Resonance Absorption in a Nickel Single Crystal at Low Temperatures.—K. H. Reich. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1647–1648.) Measurements have been made at 9 kMc/s and at 24·3 kMc/s. Values are derived for the spectroscopic splitting factor, the resonance line width and the anisotropy contents and for their variation over a range of low temperatures.

538.221 : 538.632 **2819**

Hall Effect and Magnetic Properties of Armco Iron.—S. Foner. (*Phys. Rev.*, 15th March 1956, Vol. 101, No. 6, pp. 1648–1652.) Experimental results presented previously [3625 of 1953 (Foner & Pugh)] are analysed in detail. Over a wide range of values of the magnetizing field, the Hall effect in armco iron is given by the sum of the ordinary and extraordinary effects, the extraordinary Hall constant being independent of the magnetizing field strength.

538.221 : 548.0 **2820**

Deformations in Perovskites composed of Rare Earths and Trivalent Transition Elements.—F. Bertaut & F. Forrat. (*J. Phys. Radium*, Feb. 1956, Vol. 17, No. 2, pp. 129–131.) A crystallographic study of bodies represented by the general formula A_2O_3, B_2O_3, where A is a rare earth and B one of the transition elements. The subject is important in relation to the magnetic properties of ferrites.

538.221 : 621.318.134 **2821**

Magnetic Properties of Gadolinium Ferrites.—R. Pauthenet. (*C. R. Acad. Sci., Paris*, 9th April 1956, Vol. 242, No. 15, pp. 1859–1862.) Measurements on Fe_2O_3-Gd_2O_3 and $5Fe_2O_3.3Gd_2O_3$ are reported and discussed.

538.221 : 621.318.134 **2822**

On the Magnetism of the Ferrites (La, Sr)FeO_x with Perovskite Structure.—H. Watanabe. (*Sci. Rep. Res. Inst. Tohoku Univ., Ser. A*, Feb. 1956, Vol. 8, No. 1, pp. 14–23.) Thermomagnetic studies are reported; the magnetic properties of this system of solid solutions are strongly dependent on preliminary heat treatment.

538.221 : 621.318.2 **2823**

The Definition and Determination of the Coercive Force of Permanent Magnets taking Account of Irreversible After-Effect.—A. Kussmann & O. Yamada. (*Arch. Elektrotech.*, 3rd Feb. 1956, Vol. 42, No. 4, pp. 237–244.) Calculations and measurements indicate that as a consequence of the irreversible after-effect the static coercive force of ferromagnetic materials varies with time; for alni and alnico permanent magnets the variation may amount to several per cent. A more precise definition of coercive force is required, including reference to the measuring time and an index characterizing the after-effect. The appropriate commutation rate for taking hysteresis curves is discussed.

538.224 : 546.3-1-56 **2824**

The Magnetic Susceptibilities of some Diamagnetic Alloys: the Primary Solid Solutions of Zinc, Gallium, Germanium and Arsenic in Copper.—W. G. Henry & J. L. Rogers. (*Phil. Mag.*, March 1956, Vol. 1, No. 3, pp. 237–252.) A method of alloy preparation is described. Results of measurements, by a modified Gouy method, of the rate of change of diamagnetic susceptibility with concentration of the solid solutions are presented. Conclusions are drawn regarding the states occupied by the electrons.

538.652 : 546.3-1-72-621 **2825**

Dynamic Magnetostrictive Properties of Alfenol.—C. M. Davis & S. F. Ferebee. (*J. acoust. Soc. Amer.*, March 1956, Vol. 28, No. 2, pp. 286–290.) Report of an experimental investigation of a cold-rolled Al-Fe alloy containing between 11% and 16% Al. The electromechanical coupling coefficient is comparable to that of Ni.

549.514.51 **2826**

Dislocations, Relaxations, and Anelasticity of Crystal Quartz.—H. E. Bömmel, W. P. Mason & A. W. Warner. (*Phys. Rev.*, 1st April 1956, Vol. 102, No. 1, pp. 64–71.) Experimental evidence indicates that the Q of quartz crystals varies as an inverse function of frequency between 1 and 100 Mc/s at room temperature; this variation is consistent with the existence of two relaxation processes, with time constants of 10^{-12} and $7{\cdot}7 \times 10^{-10}$ sec respectively; the first of these is probably associated with lattice distortion due to impurities, and the second with dislocation loops. An observed long-term aging effect may be due to closer pinning of dislocations by impurity atoms. A frequency standard of improved time stability might be obtained by maintaining the crystal at the temperature of liquid helium.

621.315.612 **2827**

Fundamental Factors controlling Electrical Resistivity in Vitreous Ternary Lead Silicates.—S. W. Strauss, D. G. Moore, W. N. Harrison & L. E. Richards. (*J. Res. nat. Bur. Stand.*, March 1956, Vol. 56, No. 3, pp. 135–142.) Resistivity measurements were made on a number of vitreous ternary lead silicates of widely varied compositions, as well as on vitreous silica and quartz, over the temperature range 200°–500°C, with an applied direct field of 525 V/cm. The results are presented as log-resistivity/composition curves for specimens containing alkali and alkaline-earth ions, and as log-resistivity/temperature curves for specimens containing other ions.

621.315.616 **2828**

Materials used in Radio and Electronic Engineering: Part 4—Plastics.—(*J. Brit. Instn Radio Engrs*, May 1956, Vol. 16, No. 5, pp. 283–294.) A survey including information about the physical properties and commercial availability of numerous plastics, together with British Standards and more than 50 references.

621.315.616 : 621.3.002.2 **2829**

Casting Resins insulate and protect Electronic Components.—H. L. Loucks. (*Mater. & Meth.*, Feb. 1956, Vol. 43, No. 2, pp. 90–94.) Polyester and epoxy resins, foam-type resins such as polyisocyanates and polystyrenes, and elastomeric resins such as polysulphides and silicone rubber compounds are discussed; factors to be considered in choosing the appropriate resin for a particular application are indicated; methods of embedment are outlined.

MATHEMATICS

512.3 **2830**

On Generalized Tchebycheff Polynomials.—J. L. Walsh & M. Zedek. (*Proc. nat. Acad. Sci., Wash.*, Feb. 1956, Vol. 42, No. 2, pp. 99–104.)

517 **2831**

The Method of Comparison Equations in the Solution of Linear Second-Order Differential Equations (Generalized W.K.B. Method).—R. B. Dingle. (*Appl. sci. Res.*, 1956, Vol. B5, No. 5, pp. 345–367.)

519.272 **2832**

A Simple Interpretation of the Complex Correlation Coefficient.—H. J. Linn & K. Pöschl. (*Arch. elekt. Übertragung*, March 1956, Vol. 10, No. 3, pp. 105–106.)

51 : 621.3 **2833**

Mathematische Methoden in der Hochfrequenztechnik. [Book Review]—K. Pöschl. Publishers: Springer, Berlin, 331 pp., D.M. 36. (*Wireless Engr*, June 1956, Vol. 33, No. 6, p. 156.) The first ten chapters develop the mathematics and the last five deal with its application to field problems, cavity resonators, waveguides, aerials, magnetrons, space-charge waves, etc.

MEASUREMENTS AND TEST GEAR

531.711 + 531.761 **2834**

The Standard of Length and the Standard of Time.—A. Perard. (*Nature, Lond.*, 5th May 1956, Vol. 177, No. 4514, pp. 850–851.) Critical comments on the arguments advanced by Clemence (1153 of April).

531.765 : 621.374.3 **2835**

Time-to-Pulse-Height Converter for Measurement of Millimicrosecond Time Intervals.—W. Weber, C. W. Johnstone & L. Cranberg. (*Rev. sci. Instrum.*, March 1956, Vol. 27, No. 3, pp. 166–170.) Details are given of a circuit designed to measure the time between a neutron-detector signal and the next subsequent pulse of a reference series.

538.56 : 535.51.088.2 **2836**

Errors in Measurements of an Elliptically Polarized Electromagnetic Field.—O. M. Barsukov. (*Bull. Acad. Sci. U.R.S.S., sér. géophys.*, Feb. 1956, No. 2, pp. 226–231. In Russian.) The ratio of the principal axes and the orientation of the polarization ellipse relative to a given direction can be calculated, using the

set of equations (4), from the measured ratio of the components of field strength in two known directions and the phase difference between them. The effect of an error in the orientation of the pick-up loop is considered theoretically and results of calculations are presented graphically. The graphs should be useful for finding the conditions for minimizing the effect of an error.

621.3.011.4(083.74) **2837**

A New Theorem in Electrostatics and its Application to Calculable Standards of Capacitance.—A. M. Thompson & D. G. Lampard. (*Nature, Lond.*, 12th May 1956, Vol. 177, No. 4515, p. 888.) It is shown that, for the class of cylindrical capacitors whose cross-section has at least one axis of symmetry and is bounded by a closed curve, the capacitance can be calculated from only one length determination. A preliminary study is made of a capacitance standard constituted by the space between four parallel circular cylinders whose cross-sections are arranged in a square.

621.3.018.41(083.74) + 621.396.91 **2838**

Improvements in Standard Frequencies broadcast by Radio Stations WWV and WWVH.—(*Tech. News Bull. nat. Bur. Stand.*, March 1956, Vol. 40, No. 3, pp. 37–38.) The accuracy of standard frequencies and time signals has been increased; a new uniform time, designated UT2, is used for reference.

621.3.018.41(083.74) + 621.396.91] : 529.786 **2839**

MSF Standard Frequencies expressed in Terms of the Caesium Resonance.—L. Essen. (*Wireless Engr*, July 1956, Vol. 33, No. 7, p. 178.) A note explaining a modification of the basis of the reports of standard-frequency transmissions published monthly in *Wireless Engineer*.

621.317.2 : 621.3 **2840**

Testing of Components and Valves at the Laboratoire Central des Industries Électriques.—M. A. Dauphin. (*Onde élect.*, March 1956, Vol. 36, No. 348, pp. 176–185.) An account of equipment used for electrical and life testing and quality control, and of methods used for checking the climatic and mechanical endurance of finishes.

621.317.2 : 621.373.4.029.5/.64 **2841**

The Signal Generator and its Uses in Modern Telecommunications.—J. F. Golding. (*Brit. Commun. Electronics*, Feb. 1956, Vol. 3, No. 2, pp. 75–81.) A general discussion of the signal generator as a piece of receiver test equipment. The principal characteristics of representative British-made apparatus for frequencies up to 4 kMc/s are tabulated.

621.317.3 : 621.314.7 : 546.289 **2842**

Measurements on Alloy-Type Germanium Transistors and their Relation to Theory.—Evans. (See 2903.)

621.317.32 **2843**

Measurement of Electric Field Distributions.—R. Justice & V. H. Rumsey. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 177–180.) A method which eliminates the need for a transmission line between observation point and detecting apparatus is based on introducing a thin straight conductor to act as a reflector of the field. Applications mentioned include measurements on slot aerials.

621.317.326 **2844**

Voltage Calibration System for Pulse-Height Measurement.—W. A. Rhinehart & D. J. Zaffarano. (*Nucleonics*, Feb. 1956, Vol. 14, No. 2, pp. 54, 56.) Description of a c.r.o. method of measuring pulse height by comparison of the pulse waveform with a direct voltage, the two displays alternating at mains frequency on a long-persistence screen.

621.317.335.3 + 621.317.411 **2845**

Extension of the 'Thin-Sample Method' for the Measurement of Initial Complex Permeability and Permittivity.—E. E. Conrad, C. S. Porter, N. J. Doctor & P. J. Franklin. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 346–350.) The method described e.g. by Birks (2807 of 1948) is adapted for use with a commercial dielectric-filled slotted line. The frequency range is 5 Mc/s–1 kMc/s. Errors and corrections are discussed.

2846

621.317.335.3 + 621.317.411] : 621.318.134 : 621.372.413

Measurement of Microwave Dielectric Constants and Tensor Permeabilities of Ferrite Spheres.—E. G. Spencer, R. C. LeCraw & F. Reggia. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 790–800.) Detailed account of a cavity-perturbation method using circularly polarized waves. Experimental results obtained with a polycrystalline MgMn ferrite are presented. See also 2366 of 1955.

621.317.335.3 : 621.372.413 **2847**

Calculation of the Natural Frequency of a Π-type [single re-entrant] **Cavity Partly Filled with an Absorbing Dielectric.**—Gatrushev. (See 2657.)

621.317.411 : 621.372.413 **2848**

A Re-entrant Cavity for Measurement of Complex Permeability in the Very-High-Frequency Region.—R. D. Harrington, R. C. Powell & P. H. Haas. (*J. Res. nat. Bur. Stand.*, March 1956, Vol. 56, No. 3, pp. 129–134.) The equipment described is suitable for measurements on toroidal cores at frequencies from 60 to 180 Mc/s. Design problems are discussed, calibration techniques described, and some measurement results presented.

621.317.44 : 621.384.612 **2849**

A Magnetic Differential Probe. Its Employment for the Determination of the Static Median Magnetic Surface in the Gap of a Synchrotron.—G. D. Palazzi. (*Nuovo Cim.*, 1st Feb. 1956, Vol. 3, No. 2, pp. 336–349. In English.) The probe comprises two thin ferromagnetic wires subjected to opposing magnetic fields at a frequency of 1 kc/s. The position of the probe is determined for which the components of the magnetic field along the two wires, parallel to the radius of the synchrotron and lying in a vertical plane, are equal and opposite. The technique used for preparing the wires is explained in some detail.

621.317.725.029.6 : 621.372.56 **2850**

Stable Radiofrequency Voltmeters.—(*Tech. News Bull. nat. Bur. Stand.*, Feb. 1956, Vol. 40, No. 2, pp. 29–30.) The voltmeter described, developed by Selby & Behrent at the N.B.S., comprises a waveguide piston attenuator together with a frequency-insensitive thermoelement and d.c. millivoltmeter. The piston houses the thermoelement and a built-in probe for calibrating one r.f. voltage level. The voltage range is from 0·1 V to several hundred volts, at frequencies up to about 1 kMc/s.

621.317.729 **2851**

Determination of the Intensity of the Electron Current in a Vacuum by the Use of a Rubber Membrane.—V. M. Kel'man & I. F. Krasnov. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1714–1725.)

The rubber-membrane method of investigating electron trajectories is modified so that, for the case of a cathode operating with space-charge limitation, all parameters of a two-dimensional electron beam in a two-dimensional electric field can be determined if the shapes and potentials of the electrodes are known.

621.317.729 : 621.385.2 **2852**

The Solution of the Problem of a Planar Diode with a Limited-Width Emitting Surface by Use of a Rubber Membrane.—I. F. Krasnov & V. M. Kel'man. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1726–1734.) A description is given of the apparatus used for determining the density distribution of the current at the cathode of a diode consisting of two long parallel electrodes, with emission only from a narrow middle strip of the cathode. A number of experimental curves are shown.

621.317.729.087.6 : 621.396.62 **2853**

Instruments for Recording and Automatic Analysis of Field-Strength Measurements.—H. J. Griese & E. Haberkant. (*Elektronische Rundschau*, Feb. 1956, Vol. 10, No. 2, pp. 43–46.) Modern technique is reviewed and a null instrument for field-strength measurements is described. It includes a standard signal generator and an automatically operated piston-type attenuator. The field strength is recorded by cutting a continuously moving metal foil, and this record is analysed by a simple scanning device.

621.317.733 : 621.317.33 **2854**

Bridge for Measurement of the Differential Resistance of Nonlinear Elements.—M. Mancianti. (*Alta Frequenza*, Feb. 1956, Vol. 25, No. 1, pp. 15–31.) The variation of the unbalanced bridge voltage as a function of the input voltage is shown on an oscillograph. By observing the disappearance of the derivative of the unbalanced voltage, the relation between the unknown differential resistance and the three known bridge resistances can be established. Results of measurements on a triode valve are presented.

621.317.75.029.42 : 621.396.822 **2855**

Low-Frequency Power Spectrum Analyzer.—T. E. Firle. (*Rev. sci. Instrum.*, March 1956, Vol. 27, No. 3, pp. 140–143.) A system devised for measurements of semiconductor noise in the frequency range 0·000 06–0·02 c/s [3426 of 1955 (Firle & Winston)] involves making a variable-area film recording of the noise, reproducing this at a speed increased up to 500 000-fold, and picking up the signal with a photocell whose output is fed to an a.f. analyser.

621.317.755 **2856**

A Cathode-Ray Oscillograph for the Measurement of Very Short, Aperiodic, Single, High-Voltage Phenomena.—F. Brüninghaus. (*Arch. Elektrotech.*, 3rd Feb. 1956, Vol. 42, No. 4, pp. 245–256.) A comparison of various beam-forming systems indicates that a gun with a thermionic cathode designed on the Steigerwald principle (*Optik, Stuttgart*, 1949, Vol. 5, p. 469) gives the best results in respect of small spot size and beam aperture. The signal deflection is effected by means of a parallel-wire system and the timebase deflection by a pair of plates. A timebase and blanking circuit is described giving a fixed response delay and a linear timebase adjustable between 10^{-7} and 10^{-9} sec with an oscillogram size of 6 × 9 cm.

621.317.794 **2857**

A Simple Theory for Solid-Backed Bolometers.—L. M. Roberts & S. J. Fray. (*J. sci. Instrum.*, March 1956, Vol. 33, No. 3, pp. 115–119.) A theory of the speed of response of solid-backed bolometers is developed and is applied to measurements on Nb_4N_5 superconducting bolometers. Constructional details of the bolometers used in the experimental part of the investigation are given and their characteristics are tabulated.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

621.384.612 **2858**

The Acceleration of Protons to Energies above 10 GeV.—M. L. Oliphant. (*Proc. roy. Soc. A*, 6th March 1956, Vol. 234, No. 1199, pp. 441–456.) Text of Bakerian Lecture. Methods of accelerating protons are reviewed with particular reference to proton synchrotrons. The new 10-GeV, 15-ft-radius proton synchrotron at Canberra will use magnetic fields of up to 80 000 G produced by passing currents of the order of 10^6 A in opposite directions through two suitably arranged field coils. The homopolar generator is also described.

621.384.612 **2859**

The Nonlinear Theory of Betatron Oscillations in the Strong-Focusing Synchrotron: Part 1.—Y. Orlov. (*Nuovo Cim.*, 1st Feb. 1956, Vol. 3, No. 2, pp. 252–259. In English.) Resonances due to errors in the field gradient are examined analytically.

621.384.612 **2860**

An Analysis of Injection Phenomena in the Birmingham Proton Synchrotron.—C. A. Ramm, R. F. Coe & T. B. Vaughan. (*J. sci. Instrum.*, March 1956, Vol. 33, No. 3, pp. 102–106.)

621.385.833 **2861**

Electron-Optical Image of an Atomic Beam.—L. Marton, D. C. Schubert & S. R. Mielczarek. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, p. 419.) The shadow technique (see e.g. 199 of 1950) is used to demonstrate the scattering of an electron beam by an atomic beam projected across its path.

621.385.833 **2862**

The Aperture Error of Magnetic Electron Lenses.—W. Glaser. (*Optik, Stuttgart*, 1956, Vol. 13, No. 1, pp. 7–12.) Discussion indicates that lower limits previously published for the aperture errors of rotationally symmetrical lenses cannot be confirmed.

621.385.833 **2863**

Pulsed T-F [temperature-and-field] **Emission Electron Projection Microscopy.**—W. P. Dyke & J. P. Barbour. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 356–360.)

621.386.8 : 621.397.611.2 : 620.179.1 **2864**

Large-Area Photoconductive X-Ray Pickup-Tube Performance.—J. Jacobs & H. Berger. (*Elect. Engng, N.Y.*, Feb. 1956, Vol. 75, No. 2, pp. 158–161.) Discussion of the general characteristics and the detection sensitivity of a low-velocity-scan vidicon tube and of some of its industrial applications. The advantages and disadvantages of film, direct fluoroscopy, direct-image intensifying tube and scanned-image pick-up tube for observing X-ray images are listed.

621.387.424 **2865**

Double Pulses in Rare-Gas/Halogen Geiger Counters.—D. van Zoonen. (*Appl. sci. Res.*, 1956, Vol. B5, No. 5, pp. 368–386.)

621.396.934 : 55 **2866**

Symposium on the U.S. Earth Satellite Program—Vanguard of Outer Space.—(See 2718.)

642.6 : 681.142 **2867**

Machine Translation of Languages: Fourteen Essays. [Book Review]—W. N. Locke & A. D. Booth (Eds). Publishers: Chapman & Hall, London, 48s. (*Engineering, Lond.*, 10th Feb. 1956, Vol. 181, No. 4698, p. 136.) This book includes papers given at a conference held in 1952 at the Massachusetts Institute of Technology, revised and supplemented, with a bibliography of 40 other papers. Both engineering and linguistic problems are discussed. The central engineering problem is the development of a large, cheap storage unit to hold the stem dictionary, in conjunction with a rudimentary computer.

PROPAGATION OF WAVES

538.566 **2868**

The Frequency Dependence of the Propagation of Electromagnetic Waves in Conducting Media.—J. G. Smit. (*NachrTech.*, Feb. & March 1956, Vol. 6, Nos. 2 & 3, pp. 71–75 & 121–125.) Theory is presented based on Maxwell's equations. Universal curves are prepared from considerations of the critical wavelength in the medium, the phase velocity in the nondispersive frequency range, and the reference frequency for the normalized representation. The reduced curves are constituted, to a first approximation, by two straight lines in a double-logarithmic coordinate system, intersecting at the point corresponding to unity normalized group delay time and unity normalized frequency. Formulae are derived for attenuation, refractive index and delay time for both dispersive and nondispersive ranges. Values of important parameters are tabulated for salt water, fresh water and various types of ground.

621.396.11 **2869**

Amplitude and Phase Pulsations of a Wave propagated in a Slightly Inhomogeneous Atmosphere.—V. I. Tatarski. (*C. R. Acad. Sci. U.R.S.S.*, 11th March 1956, Vol. 107, No. 2, pp. 245–248. In Russian.) The modification of the distant field by an atmosphere in which the scale of the refractive-index inhomogeneities is large compared with the wavelength is considered by a statistical method. The expressions obtained are simpler than those derived earlier by Obukhov (*Bull. Acad. Sci. U.R.S.S.*, 1953, No. 2, pp. 155–165, in Russian). See also 2024 of 1949 (Krasil'nikov).

621.396.11 : 551.510.52 **2870**

Tropospheric Scatter Propagation and a Theoretical Study of the Transmission Loss.—J. A. Fejer. (*Trans. S. Afr. Inst. elect. Engrs*, Dec. 1955, Vol. 46, Part 12, pp. 348–363. Discussion, pp. 364–367.) The internal-reflection theory of u.s.w. propagation beyond the horizon [240 of January (Carroll & King)] is critically examined; it is concluded that reflections from a smoothly varying atmosphere are too weak to account for observed field strengths. The transmission loss for propagation beyond the horizon is calculated on the assumption of scattering by turbulent fluctuations, for the case of identical transmitting and receiving aerials. For given values of distance and aerial aperture, there is a minimum value of transmission loss; this value is calculated for both the Booker-Gordon (1757 of 1950) and Villars-Weisskopf (244 of January) theories. Some applications of tropospheric scattering to communications are discussed briefly.

621.396.11 : 551.510.535 **2871**

Oblique Transmission by the Meteoric E-Layer.—R. Naismith. (*Wireless Engr*, July 1956, Vol. 33, No. 7, pp. 159–162.) A report is presented on transmissions effected during the winter of 1951 and the summer of 1952 over distances of 900–1 900 km between England and Norway, on frequencies of 22·7, 25 and 27 Mc/s. The observations indicate that propagation took place by way of the meteoric E-layer (2666 of 1954). The results confirm that this layer may enable long-distance communication to be maintained at frequencies higher than those normally propagated by way of the E and F layers.

621.396.11 : 551.510.535 **2872**

Focusing on a 'Rippled' Ionosphere.—K. Rawer. (*J. atmos. terr. Phys.*, May 1956, Vol. 8, Nos. 4/5, p. 296.) Exact formulae are given for the field strength produced by echoes of orders 1–4, assuming reflection by spherically shaped ripples in the ionosphere.

621.396.11 : 551.510.535 : 523.75 **2873**

Some Unusual Radio Observations made on 23 February 1956.—Belrose, Devenport & Weekes. (See 2717.)

621.396.11.029.55 : 621.396.93 **2874**

An Automatic Direction Finder for recording Rapid Fluctuations of the Bearing of Short Radio Waves.—Whale & Ross. (See 2744.)

621.396.11.029.6 : 535.42 **2875**

A Simple Theory of Diffraction of Radio Waves beyond the Optical Horizon.—H. Poeverlein. (*Z. angew. Phys.*, Feb. 1956, Vol. 8, No. 2, pp. 90–95.) The propagation of waves of wavelength less than about 10 m is treated by repeated application of Huygens' principle. Reflection from the earth's surface is taken into account.

621.396.11.029.6 : 621.396.96 **2876**

Prediction of Oceanic Duct Propagation from Climatological Data.—L. J. Anderson & E. E. Gossard. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. AP-3, No. 4, pp. 163–167.) Procedure is indicated whereby data obtained from routine shipboard observations of sea and air temperature, humidity and wind speed are combined to permit prediction of the coverage of low-sited microwave radar systems. Maps are presented for an area in the N.W. Pacific showing the probability of extended coverage for the radar X bands in July and December.

621.396.11.029.62 : 551.594.5 **2877**

A Theory of Scattering by Nonisotropic Irregularities with Application to Radar Reflections from the Aurora.—Booker. (See 2739.)

621.396.11.029.6 **2878**

UKW-Fernempfangsbeobachtungen, ihre Bedeutung für Meteorologie und Funktechnik. [Book Review]—L. Klinker. Publishers: Akademie-Verlag, Berlin, 1955, 68 pp., D.M. 12.50. (*Frequenz*, Feb. 1956, Vol. 10, No. 2, pp. 60–61.) Theory of u.s.w. radio propagation is presented and observations over 200-km paths with different weather conditions are analysed. Diurnal and annual field-strength variations are discussed. The common occurrence of high field strengths at distances of several hundred kilometres with m-λ transmissions is considered in relation to the planning of broadcasting services.

RECEPTION

621.376.33 : 621.372.5 **2879**

Response of Nonlinear Circuits to Oscillations modulated in Amplitude and Frequency according to an Arbitrary Law.—E. De Castro. (*Ricerca sci.*, Feb. 1956, Vol. 26, No. 2, pp. 470–481.) Fourier-series analysis is presented relevant to the operation of limiter circuits; idealized characteristics are assumed, with different properties in the positive and negative regions.

621.396.621 : 621.376.3 **2880**

Crystal-Controlled F.M. Receiver.—D. N. Corfield. (*Wireless World*, July 1956, Vol. 62, No. 7, pp. 312–316.) Circuit and constructional details are given of a fixed-tuned receiver for the three British f.m. broadcast frequencies. Three overtone crystals are used generating the local-oscillator frequencies directly, with manually operated selection switch.

621.396.621 : 621.396.812.3 **2881**

Improvement of Reception by Diversity Operation.—R. Heidester & E. Henze. (*Arch. elekt. Übertragung*, March 1956, Vol. 10, No. 3, pp. 107–116.) Calculations are made of the time averages of the signal/noise ratio for space-diversity and frequency-diversity systems; a value is derived for the average error figure in frequency-shift telegraphy. The probabilities of the signal/noise ratio exceeding or falling below a given value are determined. A practical diversity circuit is described.

STATIONS AND COMMUNICATION SYSTEMS

621.396 : 621.376.3 **2882**

Spain and Frequency Modulation.—F. Moyano Reina. (*Rev. española Electrónica*, Feb. & March 1956, Vol. 3, Nos. 15 & 16, pp. 54–57, 79 & 51–53 . . 57.) Frequency allocations and coverage problems are discussed with special reference to Spain, and the advantages, both for peace-time and war-time, of v.h.f. operation with f.m. are indicated. An appropriate development plan has been laid before the Government by the First Congress of Telecommunication Engineers.

621.396.41 : 621.396.822.1 **2883**

Spectral Density of Cross-Modulation Noise.—R. Codelupi. (*Alta Frequenza*, Feb. 1956, Vol. 25, No. 1, pp. 38–64.) Detailed analysis is presented for a multi-channel transmission system considered as a cascaded series of alternate nonlinear and phase-distorting quadripoles, and assuming that the probability distribution at the input is Gaussian.

SUBSIDIARY APPARATUS

621.314.1 : 621.373.52 : 621.314.7 **2884**

The Design and Operation of Transistor D.C. Converters.—(*Mullard tech. Commun.*, Feb. 1956, Vol. 2, No. 17, pp. 157–204.) Circuits are discussed in which a junction transistor is made to oscillate and thus to chop the current from a battery; the chopped current is fed to a transformer or ringing choke, and the stepped-up-voltage output is rectified and smoothed. Design procedures are described in detail. See also 573 of February.

621.314.63 : [546.28 + 546.289 **2885**

Germanium and Silicon Power Rectifiers.—T. H. Kinman, G. A. Carrick, R. G. Hibberd & A. J. Blundell. (*Proc. Instn elect. Engrs*, Part A, April 1956, Vol. 103, No. 8, pp. 89–107. Discussion, pp. 107–111.) The development of *p-n*-junction power rectifiers is reviewed and the special features of a unit rated up to 2 kW are described. For a shortened version, see *J. Instn elect. Engrs*, March 1956, Vol. 2, No. 15, pp. 144–151.

621.314.63 : 546.289 **2886**

Germanium Power Rectifiers.—M. Sassier. (*Onde élect.*, March 1956, Vol. 36, No. 348, pp. 224–229.) The production and characteristics of Ge junction rectifiers capable of handling current densities of the order of 100 A/cm² at an ambient temperature of 60°C are described and compared with those of other rectifiers. Some suitable circuits are indicated.

621.316.722.1 **2887**

An A.C. Voltage Stabilizer.—F. A. Benson & M. S. Seaman. (*Electronic Engng*, June 1956, Vol. 28, No. 340, pp. 260–265.) A temperature-limited diode placed in one arm of a resistance bridge controls the output voltage through a saturable reactor and autotransformer.

621.352.3 **2888**

Wafer Cells.—R. W. Hallows. (*Wireless World*, July 1956, Vol. 62, No. 7, pp. 341–343.) The Burgess (U.S.A.) dry battery is described and discharge characteristics are given. The cells are of sandwich construction, hermetically sealed, and the construction affords substantial savings in size and weight as compared with earlier types of dry battery.

TELEVISION AND PHOTOTELEGRAPHY

621.397(083.7) **2889**

I.R.E. Standards on Facsimile: Definitions of Terms, 1956.—(*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 776–781.) Standard 56 I.R.E. 9. S1.

621.397.26 : 621.396.65.029.63 **2890**

The Microwave System between London and Windsor in Canada.—A. D. Hodgson & G. M. B. Wills. (*G.E.C. Telecommun.*, Feb. 1956, No. 21, pp. 4–24.) The television link described provides two one-way reversible channels and includes four repeater stations separated by up to 26·4 miles; the f.m. transmitters operate in the 1·7–2·3-kMc/s band with output power of about 2 W.

621.397.5 : 535.623 **2891**

Colour Television.—H. Anglès d'Auriac. (*Onde élect.*, Feb. & March 1956, Vol. 36, Nos. 347 & 348, pp. 134–144 & 277–282.) The development and present practice of colour television in the U.S.A. are reviewed, in order to point the way for development of a European service. Differences in economic and technical factors between the two continents are emphasized.

621.397.62 **2892**

Some Remarks on the Radio-Frequency Phase and Amplitude Characteristics of Television Receivers.—A. van Weel. (*J. Brit. Instn Radio Engrs*, May 1956, Vol. 16, No. 5, pp. 271–280.) "The influence on the picture of the steady state characteristics of the radio frequency part of a television receiver is considered especially for the frequencies close to the carrier frequency (the so-called Nyquist flank). It follows from numerical calculations that the shape of the amplitude characteristics of this Nyquist flank has but little influence on the picture quality. The performance of a receiver will be substantially the same in combination with a double-sideband transmitter as with a vestigial-sideband transmitter, provided the latter has been compensated for its own phase errors. The performance of a vestigial-sideband transmitter should be monitored with a phase-linear receiver, of which the exact shape of the Nyquist flank is not very critical."

621.397.62 : 621.373.43 **2893**

Television Sweep Generation with Resonant Networks and Lines.—K. Schlesinger. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 768–775.) Circuits for producing horizontal-deflection current waveforms with economical use of power are discussed. Such waveforms can be obtained by synthesis from a limited number of harmonics of a sinusoidal oscillation. Satisfactory linearity can be obtained using only four harmonics, if their relative amplitudes are slightly adjusted, but to achieve a retrace time not greater than 15% eight harmonics must be used. Various circuits using shock excitation of multiresonators have been tried. The best multiresonator found was a delay line just under $\lambda/2$ long; a construction which minimizes dispersion is described.

621.397.62 : 621.397.8 **2894**

Television Pattern Eliminator.—(*Wireless World*, July 1956, Vol. 62, No. 7, p. 307.) Band-I interference experienced when receiving band III with a band-I set and converter is balanced out by an equal, oppositely phased signal.

621.397.7 **2895**

Südwestfunk Television Studio Technique.—(*Tech. Hausmitt. NordwDtsch. Rdfunks*, 1956, Vol. 8, Nos. 1/2, pp. 1–39.) Eight individual papers are presented, dealing with various aspects of the Baden-Baden television centre; these include the general plan, the program handling equipment, the lighting and back-projection, the transmission chain, and the use of 16-mm film.

621.397.7 **2896**

The New B.B.C. Television Station at the Crystal Palace.—(*J. Telev. Soc.*, Jan.–March 1956, Vol. 8, No. 1, pp. 35–36 . . 40.) A brief description of this station, which took over the service from Alexandra Palace in March 1956. The station transmits on 45 Mc/s (vision) and 41·5 Mc/s (sound) with a vestigial-upper-sideband characteristic.

621.397.8 **2897**

Definition of the Signal/Noise Ratio due to Statistical Fluctuations in Television.—R. Theile & H. Fix. (*Arch. elekt. Übertragung*, March 1956, Vol. 10, No. 3, pp. 98–104.) The amplitude distribution of fluctuations in television signals is discussed; oscillograms obtained with different pickup systems are compared. Experiments to determine the disturbing effect of fluctuations at different brightness levels are reported. A new method is proposed for defining signal/noise ratio based on measurements at three signal levels, corresponding respectively to black, white, and a selected grey.

621.397.8 : 535.623 **2898**

Television Picture Quality.—W. T. Cocking. (*Wireless Engr*, July 1956, Vol. 33, No. 7, pp. 157–158.) A brief discussion of factors affecting vertical and horizontal picture definition, in relation to the decision yet to be made regarding the line standard to be adopted for colour television in Great Britain.

621.397.82 **2899**

Interference with Television Reception: some Causes and Cures.—R. A. Dilworth. (*J. Telev. Soc.*, Jan.–March 1956, Vol. 8, No. 1, pp. 3–15.) Complaints of interference received by the British Post Office in 1954–1955 were attributed to commutator motors, contact devices, power lines, filament lamps, discharge lamps, receiver oscillators, ignition, transmitters, industrial and medical equipment, and faulty electric wiring, in descending order of frequency of occurrence. No serious difficulty is foreseen in suppressing interference generated by motor-driven machines, but other sources still present many practical problems.

TRANSMISSION

621.396.61 : 621.376.22 **2900**

Anode Self-Modulation, a High-Frequency-Engineering Paradox.—F. H. Lange. (*NachrTech.*, Feb. 1956, Vol. 6, No. 2, pp. 58–62.) Anode self-modulation is a term applied to an a.m. process for a transmitter output stage in which a.f. and h.f. control are effected in the grid circuit. The arrangement is equivalent to a reflex type of constant-current anode-voltage modulator using a.f. choke. Features distinguishing the operation of this circuit from the ordinary grid modulator are indicated.

VALVES AND THERMIONICS

621.314.63 : 546.28 **2901**

The Blocking Properties of Alloyed Si-Junction Rectifiers.—A. Herlet & H. Patalong. (*Z. Naturf.*, July 1955, Vol. 10a, No. 7, pp. 584–586.) Rectifiers of this type generally have a p-s-n structure [2776 of 1955 (Herlet & Spenke)]. The relation between the breakdown voltage and resistivity has been investigated for specimens with high-resistivity p-type middle zones; the relation is not linear. It is deduced that the critical field strength depends markedly on the resistivity.

621.314.7 **2902**

The Determination of Base Thickness in Alloy-Junction Transistors by Etching.—J. Rolfe. (*Brit. J. appl. Phys.*, March 1956, Vol. 7, No. 3, pp. 109, 112.) The geometry of In p-n junctions in Ge is investigated by using a short-duration (20 or 30 s) C.P.4 etch [1928 of 1951 (Haynes & Shockley)]. The method is described and photographs of junctions are shown.

621.314.7 : 546.289 : 621.317.3 **2903**

Measurements on Alloy-Type Germanium Transistors and their Relation to Theory.—D. M. Evans. (*J. Electronics*, March 1956, Vol. 1, No. 5, pp. 461–476.) Two methods of determining the current amplification α are described. On the basis of an injection ratio of unity, the frequency dependence of α is compared with the theoretical variation of the base transport factor β obtained from the equations of the one-dimensional minority-carrier-diffusion theory. The comparison confirms the applicability of this theory, and further confirmation is obtained by consideration of the variation of emitter/base impedance with emitter current. The results are applied to show that the mobility of holes in n-type Ge varies as $T^{-2.3}$ and that the effective diffusion constant is doubled in going from small to large emitter currents. Three methods for estimating the effective base thickness are described.

621.314.7.012.8 **2904**

Transistor Equivalent Circuits.—J. Gaschi. (*Onde élect.*, March 1956, Vol. 36, No. 348, pp. 268–276.) Equivalent circuits representing the behaviour of fused-junction p-n-p transistors at high frequencies are discussed based on the solution of the diffusion equation; eight elements are involved. Practical formulae for the principal parameters are derived.

621.383.2 **2905**

The Time Lag and other Undesirable Phenomena observed in Vacuum Photo-tubes at Weak Illumination: Part 1.—M. Sugawara. (*J. phys. Soc. Japan*, Feb. 1956, Vol. 11, No. 2, pp. 169–175.) Experiments have been made to determine the causes of nonlinearity and time-varying response in photoemissive cells. Abnormal effects are mainly due to photoemissive materials such as Cs adhering to parts of the cell wall in poor contact with the photocathode.

621.385 **2906**

Origin and Analysis of Gas in Electron Tubes.—S. J. Stoll. (*Brit. J. appl. Phys.*, March 1956, Vol. 7, No. 3, pp. 94–96.) The gas liberated during electron bombardment of the anode is mainly CO which is probably produced by a reaction between the CO_2 and the Ba absorbed during cathode conversion. By keeping the anode at 600°C or higher temperatures during cathode conversion and removing the CO_2 by pumping, valves have been made which were relatively free of gas and required no aging.

621.385 **2907**

Axially Symmetrical Electron Beams of Given Shape.—V. T. Ovcharov. (*C. R. Acad. Sci. U.R.S.S.*, 1st March 1956, Vol. 107, No. 1, pp. 47–50. In Russian.) Equations are derived for the field required to produce a beam of given shape. Space-charge effects are taken into account.

621.385.012 **2908**

An Analysis of Grid Current.—W. Knappe. (*Frequenz*, Feb. 1956, Vol. 10, No. 2, pp. 44–50.) The d.c. and first three harmonic components of grid current are calculated as functions of the fraction of the cycle during which grid current flows. The overall r.m.s. value and the separate r.m.s. values for even and odd harmonics are also determined for various V_g/I_g characteristics. Results are shown graphically.

621.385.029.6 **2909**

Space-Charge Effects in Dense, Velocity-Modulated Electron Beams.—M. Weinstein & H. M. Von Foerster. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 344–346.) The motion of electrons in the drift space of a klystron is examined; the de-bunching effect is analysed using a coordinate system moving at a speed equal to the initial speed of the electrons, space-periodic rather than time-periodic distributions being considered. A discrete spectrum of beam oscillations is deduced, with the plasma frequency as limiting frequency. The results are supported by observations with a beam analyser [e.g. 2379 of 1955 (Purl & Von Foerster)].

621.385.029.6 **2910**

Calculation of the Performance Chart of Magnetrons.—W. Praxmarer. (*NachrTech.*, March 1956, Vol. 6, No. 3, pp. 97–104.) From consideration of limiting conditions and estimates of mean values, analytical relations are derived between anode voltage, anode current, overall efficiency and power of a magnetron, thus permitting advance calculation of the characteristics. Predictions have been checked by measurements on various types of magnetron at wavelengths between 1·21 and 33·5 cm with pulsed and continuous operation. No large errors result from space charge, but the effect of the load on the efficiency is difficult to predict; the theoretical results are however sufficiently accurate for practical purposes.

621.385.029.6 **2911**

Design Information on Large-Signal Traveling-Wave Amplifiers.—J. E. Rowe. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 818–819.) Addendum to 1589 of May.

621.385.029.6 : 537.533 **2912**

Excitation of Space-Charge Waves in Drift Tubes.—M. Scotto & P. Parzen. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 375–381.) "An analysis has been made of the effect of initial conditions on the excitation of electromagnetic waves in a drift tube. The method employs the Laplace transform which directly includes the initial quantities. Field quantities which have been transformed with respect to the longitudinal coordinate are solved for and the results then inverted. Explicit expressions are then obtained for the velocity, charge density, and current density modulations as a series of modes."

621.385.029.6 : 538.566 : 537.56 **2913**

Growing Electric Space-Charge Waves.—Piddington. (See 2702.)

621.385.029.6 : 621.372.8 **2914**

Nonlinear Phenomena in a Waveguide in the Presence of an Electron Beam with Nearly Equal Electron and Wave Velocities.—L. N. Loshakov. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1768–1787.) By considering a model consisting of a waveguide with a dielectric in which free movement of electrons is postulated, theory based on the method of successive approximations is developed. The theory is used to estimate nonlinear phenomena characterizing the interaction of the beam with the field of the travelling wave for nearly equal velocities of the electrons and waves.

621.385.029.6 : 621.374.4 **2915**

The Frequency-Multiplier Klystron.—V. J. Norris. (*J. Electronics*, March 1956, Vol. 1, No. 5, pp. 477–486.) "The factors controlling design and performance of frequency-multiplier klystrons are examined and the conclusions drawn are checked against the performance of the VX 8175, a tube driven at 937·5 Mc/s and delivering about 100 mW of c.w. power at 9 375 Mc/s. Good agreement between theory and practice is found despite limitations of the former."

621.385.032.213 **2916**

Measurement of the Cathode Temperature in Triodes by the Method of Initial Current.—A. E. Gershberg. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1703–1713.) Development of a method described e.g. by Ikehara (3405 of 1954).

621.385.032.216 **2917**

Current/Voltage Characteristics of the Oxide-Coated Cathode at Low Activation Energies.—R. E. J. King. (*Research, Lond.*, March 1956, Vol. 9, No. 3, pp. S9–S10.) The I/V characteristics in the temperature range 300°–600° K have been determined by applying a sinusoidal voltage across the coating and a small series resistance, and observing the variation of the voltage across the latter. Assuming the characteristic to be represented by an equation of the form $I = aV + bV^2 + \ldots$, the coefficients of the power series can be evaluated from the harmonics in the observed variation. The deviation from linearity decreases with increasing temperature over the range examined. Possible mechanisms giving rise to the observed results are briefly discussed.

621.385.032.216 **2918**

Impregnated Barium Dispenser Cathodes containing Strontium or Calcium Oxide.—I. Brodie & R. O. Jenkins. (*J. appl. Phys.*, April 1956, Vol. 27, No. 4, pp. 417–418.) Tests have been made on cathodes of the type described by Levi (3125 of 1955) modified by addition of CaO or SrO to the barium silicate or barium aluminate impregnant. Emission/temperature characteristics are shown; the additions lead to increased emission in all cases.

621.385.15 **2919**

The Secondary-Emission Valve and its Application.—A. H. Atherton. (*J. Telev. Soc.*, Jan.–March 1956, Vol. 8, No. 1, pp. 23–29.) Consideration is confined to valves with a single stage of multiplication. By comparison with the conventional valve, the secondary-emission valve has the advantage that a high gain-bandwidth product can be obtained more easily in practice, and that an output in phase with the input is obtained from the dynode. Difficulties in achieving stability of characteristics over the lifetime are discussed and two commercially available stable types are briefly described. The required operating voltages and the noise are both high compared with the values for conventional valves. The use of secondary-emission valves merits consideration when designing for bandwidths > 10 Mc/s.

621.385.2 : 621.317.729 **2920**

The Solution of the Problem of a Planar Diode with a Limited-Width Emitting Surface by Use of a Rubber Membrane.—Krasnov & Kel'man. (See 2852.)

621.385.4/.5 **2921**

Non-additivity in Selenium Photocells with Barrier Layers under the Influence of an External Voltage.—Z. A. Gol'dman. (*Zh. tekh. Fiz.*, Sept. 1955, Vol. 25, No. 10, pp. 1689–1695.) If a Se photocell is simultaneously illuminated by light waves of different wavelengths, the resulting photocurrent may greatly exceed the sum of the currents obtained with separate illuminations. Experiments have shown that short-wave illumination removes the barrier layer and the resistance due to it, so that the decrease in the resistance of the Se caused by long-wave illumination results in an amplification of the photocurrent.

621.385.832 **2922**

Deposition and Removal of Electric Charges on Insulators by Secondary Emission: Part 2.—M. Barbier. (*Ann. Radioélect.*, July 1955, Vol. 10, No. 41, pp. 303–323.) Experiments are reported providing the basis for the theory presented previously (2262 of July). Special c.r. tubes were used to facilitate observations of the electron movements with different field distributions. Results indicate that a high-voltage beam should be used for writing and a low-voltage beam for reading, in conjunction with a perfect insulator.

621.385.832 : 681.142 **2923**

Coplanar-Mesh Storage.—G. R. Hoffman. (*Brit. J. appl. Phys.*, March 1956, Vol. 7, No. 3, pp. 102–108.) A storage system is described using a c.r. tube with a target consisting of a sheet of mica on to which a conducting mesh has been evaporated. In this system the writing is controlled by the bright-up pulses alone and transient voltages on the mesh are eliminated.

621.385.832 : 681.142 **2924**

The Hyperbolic-Field Tube, an Electron-Beam Tube for Multiplication in Analogue Computers.—W. Schmidt. (*Z. angew. Phys.*, Feb. 1956, Vol. 8, No. 2, pp. 69–75.) The tube comprises three deflector systems and a pair of target anodes. The first and third deflectors are pairs of X and Y plates, respectively, the second comprises four cross-connected plates with hyperbolic section in the xy plane, oriented with the asymptotes along the axes. The deflection of the electron beam in the y direction in the second deflector is proportional to the x displacement produced by the first deflector. A control voltage depending on the difference between the currents collected by the two target anodes is fed back to the third deflector to produce equal currents in the target anodes; its value is then proportional to the required product of the voltages applied to the first and second deflectors.

621.387 **2925**

Experiments with Gas-Filled Triodes.—J. A. Kok. (*Appl. sci. Res.*, 1956, Vol. B5, No. 6, pp. 445–453.) "In this paper experiments are described showing the different types of electrical discharges in a gas-filled triode. The determining parameters are the following: the cathode emission, the spacing of cathode, grid and anode, the diameter of the meshes of the grid, the potentials of the grid and the anode, the gas pressure and the differential ionization function of the gas. The anode voltage may be concentrated in a space charge sheath. If this space charge sheath is located at the grid, the anode current may be modulated with moderate grid potentials. If not, much larger voltages are required for modulation."

621.387 **2926**

The Hydrogen Thyratron.—D. Charles & R. J. Warnecke. (*Ann. Radioélect.*, July 1955, Vol. 10, No. 41, pp. 256–302.) A detailed study is reported of the pulsed operation of the medium-power thyratron Type-T.G.200. The variations of grid and anode currents and voltages were measured both during the passage of the pulses and during the intervals. An estimate was made of the power required to control the valve with positive grid. The curve showing dissipated power as a function of time is characterized by a peak corresponding to the initiation of ionization. Bombardment of the anode by ions in the period immediately after the pulse must be taken into account in developing new valves. 49 references.

621.387 **2927**

Investigation of a New Continuously Controllable Gas Discharge using a Cold Cathode.—C. H. Hertz. (*Ark. Fys.*, 7th Feb. 1956, Vol. 10, Part 3, pp. 213–245. In German.) An account is given of the design and operation of a corona valve developed as a result of experiments described previously (e.g. 1938 of 1955). A negative point corona serves as cathode, and the anode system comprises an array of fine tungsten wires arranged in parallel grooves cut in a brass plate serving as control grid; the operation depends on the provision of a very strong electric field in the neighbourhood of the anode wires. When such a discharge is operated in hydrogen at a pressure of 150 mm Hg its characteristics resemble those of a vacuum valve, the amplification factor being 50–100. The internal resistance is negative. Use of the valve as an amplifier may be restricted by considerations of noise and frequency range, but it should be useful for stabilization.

MISCELLANEOUS

621.3.002.2 : 68 **2928**

Dip Soldering.—H. G. Manfield. (*Wireless World*, July 1956, Vol. 62, No. 7, pp. 304–306.) A simple method evolved at the British Radar Research Station for use with printed circuits is described.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.112 **2929**

Investigation of the Dependence of the Number of Antinodes on a Linear Elastic Body on the Tension of the Individual Mass Elements, as demonstrated by Transverse Waves on Strings.—H. Fark. (*Frequenz*, March 1956, Vol. 10, No. 3, pp. 89–91.)

534.121.1 **2930**

Vibrations of a Rectangular Plate with Distributed Added Mass.—H. Cohen & G. Handelman. (*J. Franklin Inst.*, March 1956, Vol. 261, No. 3, pp. 319–329.)

534.2-14 **2931**

An Estimate of the Effect of Turbulence in the Ocean on the Propagation of Sound.—J. A. Knauss. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 443–446.)

534.2-8-14 **2932**

The Absorption of Ultrasonic Waves in Water and its Dependence on the Temperature and Air Content of the Water.—S. K. Mukhopadhyay. (*Acustica*, 1956, Vol. 6, No. 1, pp. 25–34. In German.)

534.21-16 : 549.514.5 **2933**

Propagation of Longitudinal Waves and Shear Waves in Cylindrical Rods at High Frequencies.—H. J. McSkimin. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 484–494.) General theory is presented, and experimental results are reported for propagation at 10–25 Mc/s in fused-silica rods of radius 1·13 cm.

534.22-14 : 546.212 **2934**

Temperature Coefficient of the Speed of Sound in Water near the Turning Point.—M. Greenspan, C. E. Tschiegg & F. Breckenridge. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, p. 500.) Results of measurements at a frequency of 15·3 kc/s and temperatures between 70° and 77·5°C are presented graphically. The temperature coefficient α_c is given by the formula $-25{\cdot}9\,(T - 73{\cdot}95) \times 10^{-8}$/°C and the calculated velocity is 1 555·5 m/s at the turning point 73·95°C.

534.22-14 : 546.212 **2935**

Effect of Dissolved Air on the Speed of Sound in Water.—M. Greenspan & C. E. Tschiegg. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, p. 501.) The effect of dissolved air does not exceed 1 part in 10^3 at temperatures of 31·8° and 0°C.

534.231 **2936**

The Radiation Force on a Spherical Obstacle in a Cylindrical Sound Field.—T. F. W. Embleton. (*Canad. J. Phys.*, March 1956, Vol. 34, No. 3, pp. 276–287.) A general expression is obtained for the radiation force in terms of the complex amplitudes of spherical harmonics required to synthesize the incident field. The results are qualitatively the same as for a spherical field (1636 of 1954), but the point at which the force changes from attraction to repulsion, for a given obstacle size and sound frequency, is nearer the source.

534.232 **2937**

Directional Circular Arrays of Point Sources.—W. Welkowitz. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 362–366.) The Fourier-series solution for the radiation field of a circular current sheet presented by LePage et al. (31 of 1951) is applied to the synthesis of a sound field expressed in the form of a Tchebycheff polynomial. This leads to an exact solution in closed form for the amplitude and phase of excitation of the transducer elements when the main lobe width of the radiation pattern, the side-lobe suppression and the array circle diameter are specified. Some numerical results are given.

534.24 + [538.566 : 535.42 **2938**

Fourier-Transform Method for the Treatment of the Problem of the Reflection of Radiation from Irregular Surfaces.—W. C. Meecham. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 370–377.)

534.52 **2939**

Scattering of Sound by Sound.—U. Ingard & D. C. Pridmore-Brown. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 367–369.) "Calculations and measurements are reported of the summation and difference frequency components which are scattered from the interaction region of two sound beams in air intersecting each other at right angles."

534.64 + 621.317.73 **2940**

An Impedance Measuring Set for Electrical, Acoustical and Mechanical Impedances.—Ayers, Aspinall & Morton. (See 3149.)

534.64 **2941**

Some Notes on the Measurement of Acoustic Impedance.—O. K. Mawardi. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 351–356.) The theory of a plane-wave method of measuring the acoustic impedance of a specimen in a tube is developed and the effect of surface irregularities is investigated.

534.75 **2942**

Intelligibility of Diphasic Speech.—G. E. Peterson, E. Sivertsen & D. L. Subrahmanyam. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 404–411.) The effect on intelligibility of the switching rate at which successive portions of the speech signal are reversed in phase was investigated; the intelligibility was high at switching frequencies up to 100 c/s.

534.78 : 621.39 **2943**

The Vobanc—a Two-to-One Speech Bandwidth Reduction System.—B. P. Bogert. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 399–404.) The Vobanc (voice band compression) system is described and the characteristics of experimental equipment are given. See also 2605 of September (Kock).

534.79 **2944**

The Significance of the 'Frequency Group' for the Loudness of Sounds.—H. Bauch. (*Acustica*, 1956, Vol. 6, No. 1, pp. 40–45. In German.) Report of an experimental investigation of the effect on the subjective loudness of a complex tone of the frequency separation of the component tones, for different absolute frequencies, intensity levels and relative phases. The 'frequency group' is the term applied to a critical bandwidth; for lower values of bandwidth the ear assesses the loudness as for a single tone. Intensity fluctuations can still be perceived at frequencies < 3 c/s.

534.833.4 : 538.569.2/.3].029.6 **2945**

Absorption Devices for Centimetre Electromagnetic Waves and their Acoustic Analogues.—Meyer & Severin. (See 3037.)

534.844/.845 **2946**

Determination of the Form of Reverberation Chambers for Measurements.—G. Venzke. (*Acustica*, 1956, Vol. 6, No. 1, pp. 2–11. In German.) The influence of the shape and size of the reverberation chamber on the measurement results obtained has been investigated experimentally; procedure recommended in German Standard DIN 52212 was used. For comparison, calculations were made of the curvature to be expected in the reverberation curves for rectangular rooms of different sizes. In addition, independent measurements were made of the absorption coefficient of a particular material in two separate sets of rooms, each set ranging in volume from 83 to 258 m³. The results indicate that the uncertainty of measurements increases with decrease of room size, especially for highly absorbent materials. Rooms with non-parallel plane walls are not necessarily better than rectangular rooms.

534.846.6 **2947**

Accuracy of Matching for Bounding Surfaces of Acoustic Models.—A. F. B. Nickson & R. W. Muncey. (*Acustica*, 1956, Vol. 6, No. 1, pp. 35–39.) A theoretical study is reported of the extent to which precise matching of the specific acoustic impedance of the surfaces of the model with those of the original space is possible or necessary.

534.861.1 : 621.376.223 **2948**

Sound Transformations in Broadcasting Studio Technique, particularly by Application of Frequency Conversion.—L. Heck & F. Bürck. (*Elektronische Rundschau*, Jan. 1956, Vol. 10, No. 1, pp. 1–7.) The production of special sound effects particularly by means of a ring modulator, is discussed.

621.395.616 **2949**

Air-Stiffness Controlled Condenser Microphone.—T. J. Schultz. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 337–342.) The construction and characteristics of small microphones using rubber hydrochloride (pliofilm), vinylidene chloride (saran), or polyethylene terephthalate (mylar) membranes, are described.

621.395.623.7.012 **2950**

A Method for the Measurement of the Directivity Factor [of loudspeakers].—G. Sacerdote & C. B. Sacerdote. (*Acustica*, 1956, Vol. 6, No. 1, pp. 45–48.)

2951

621.395.625.3 + 621.395.92 + 621.396.62] : 621.314.7

Transistor Circuitry in Japan.—(See 3204.)

621.395.625.3 : 534.86 **2952**

An Acoustic Time-Regulator for Sound Recordings.—A. M. Springer. (*Elektrotech. Z., Edn B*, 21st March 1956, Vol. 8, No. 3, pp. 93–96.) The reproduction of a magnetic-tape recording may be expanded or compressed in time, without changing the pitch, by changing the speed of the tape and simultaneously moving the pick-up head so as to keep their relative speed constant. This is achieved by using a quadruple rotating pick-up head in conjunction with the mechanical coupling to the tape-drive motor described. For a short description, in English, see *Electronics*, June 1956, Vol. 29, No. 6, pp. 184–188.

AERIALS AND TRANSMISSION LINES

621.315.212.011.3 **2953**

The Mean Geometrical Distances of a Circle.—H. Schering. (*Elektrotech. Z., Edn A*, 1st Jan. 1956, Vol. 77, No. 1, pp. 12–13.) Simple formulae are derived for the mean distances of a circle from itself and from a surface enclosed by it. The formulae involve power series whose convergence is such that they need not be taken beyond the quadratic term. Further formulae are derived for the inductance of coaxial lines with inner conductors of various cross-sections.

621.372.2 **2954**

Theory of Helical Lines.—S. Kh. Kogan. (*C. R. Acad. Sci. U.R.S.S.*, 1st April 1956, Vol. 107, No. 4, pp. 541–544. In Russian.) The dispersion characteristics of helical lines are derived, taking into account both of the orthogonal components of the current in the case of a thin helical strip or of the field in a helical slit cut in a thin metallic cylinder. Calculated characteristics for three different conductor-width/spacing ratios are presented graphically.

621.372.2 **2955**

The Propagation of Electromagnetic Waves along a Helical Strip in a Circular Waveguide.—E. V. Anisimov & N. M. Sovetov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1965–1971.) Theory is developed for the case of an ideally conducting strip. The e.m. wave at certain frequencies is the sum of a number of components; these are given by equations (16). The results can be applied to more complex helical systems.

621.372.2 : 621.372.8 **2956**

Electromagnetic Surface Waves in Rectangular Channels.—M. A. Miller. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1972–1982.) The conditions necessary for a surface wave to be guided by a rectangular channel are discussed; no surface waves can be present in a channel with an ideally conducting bottom. Analysis is presented for two systems which would act as waveguides: (*a*) channels with longitudinal or transverse partitions on the bottom, and (*b*) channels with curved bottom. The optimum operating conditions are established for these two cases.

621.372.8 **2957**

Transitions from the TE_{01} Mode in a Rectangular Waveguide to the TE_{11} Mode in a Circular Waveguide.—F. Mayer. (*J. Phys. Radium*, March 1956, Vol. 17, Supplement to No. 3, *Phys. appl.*, pp. 52A–53A.) Brief descriptions are given of a graded-cross-section coupling of length about 12 cm, and of a $\lambda/4$ transformer giving satisfactory operation over a 500-Mc/s band centred on 9·35 kMc/s.

621.372.8 : 538.221 : 538.614 **2958**

Ferrites in Waveguides.—G. H. B. Thompson. (*J. Brit. Instn Radio Engrs*, June 1956, Vol. 16, No. 6, pp. 311–328.) A survey covering the theory of the gyromagnetic mechanism controlling the microwave permeability of a ferrite, and of wave propagation in circular or rectangular waveguides containing longitudinally or transversely magnetized ferrites. Devices based on resonance absorption or on nonreciprocal transmission are described, including gyrators, isolators and phase circulators; the different types are compared in respect of ease of construction and performance at a single frequency or over a band. Methods of measuring the components of the ferrite permeability tensor are discussed.

621.372.8 : 621.318.134 **2959**

Broad-Band Nonreciprocal Phase Shifts—Analysis of Two Ferrite Slabs in Rectangular Guide.—S. Weisbaum & H. Boyet. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 519–524.) A differential phase shift equalized over a wide frequency band can be produced by using two ferrite slabs of different thickness and magnetic properties but magnetized in the same direction. Analysis is given for the general case. Examination of a particular example indicates that a differential phase shift of π can be obtained constant to within $\pm 2{\cdot}5\%$ over the frequency range 5·925–6·425 kMc/s using ferrite slabs 5·4 in. long in a waveguide 1·59 in. wide.

621.396.674.3 **2960**

Radiation from an Electric Dipole in the Presence of a Corrugated Cylinder.—J. R. Wait. (*Appl. sci. Res.*, 1956, Vol. B6, Nos. 1/2, pp. 117–123.) "A solution is outlined for the problem of an electric dipole which is located outside and parallel to the axis of a circular cylinder of infinite length. The corrugated surface of the cylinder is assumed to be described by an anisotropic boundary impedance which specifies the ratios of the tangential electric and magnetic fields. It is shown that, in general, the radiated field is elliptically polarized."

621.396.674.3 : 621.396.11 **2961**

Radiation from a Vertical Antenna over a Curved Stratified Ground.—Wait. (See 3190.)

621.396.677.71 **2962**

Calculated Radiation Characteristics of Slots cut in Metal Sheets: Part 2.—J. R. Wait & R. E. Walpole. (*Canad. J. Technol.*, March 1956, Vol. 34, No. 2, pp. 60–70.) "Theoretical radiation patterns are presented for antennas consisting of a notch cut in the edge of a perfectly conducting half-plane and a vanishingly thin elliptic cylinder. The principal plane patterns for these two cases are found to be very similar. The conductance of the notch is also considered." Part 1: 3160 of 1955. See also 1309 of May (Frood & Wait).

621.396.677.833 **2963**

Aerial with Wide-Lobe Radiation Pattern.—L. Thourel. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 348–354.) The design of a parabolic-reflector aerial with a sector-shaped radiation pattern is discussed, such as is desirable for long-range surveillance radar installations. Analysis indicates that the optimum radiation pattern for the primary radiator consists of a principal lobe with two counter-phased side lobes; a suitable arrangement for producing such a pattern is a twin-horn radiator. Experimental results supporting the theory are presented.

621.396.677.85 **2964**

Designing Dielectric Microwave Lenses.—K. S. Kelleher. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 138–142.) Design data for Maxwell, Luneberg, Eaton, Kelleher and modified types of variable-refractive-index lenses.

AUTOMATIC COMPUTERS

681.142 **2965**

The Logical Design of an Idealized General-Purpose Computer.—A. W. Burks & I. M. Copi. (*J. Franklin Inst.*, March & April 1956, Vol. 261, Nos. 3 & 4, pp. 299–314 & 421–436.) A detailed discussion emphasizing the distinction between the logic requirements and the particular physical form of a digital computer.

681.142 **2966**

Analog Computers for the Engineer.—J. M. Carroll. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 122–129.) A review of computer techniques, with tabulated data for some 20 commercially available types.

681.142 **2967**

Electronic Methods of Analogue Multiplication.—Z. Czajkowski. (*Electronic Engng*, July & Aug. 1956, Vol. 28, Nos. 341 & 342, pp. 283–287 & 352–355.) A general survey of the principles used; different systems are compared as to accuracy, speed and complexity.

681.142 **2968**

High-Speed Electronic-Analogue Computing Techniques.—D. M. MacKay. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 558–559.) Discussion on 3499 of 1955.

681.142 **2969**

An Analog Computer for the Solution of Tangents.—F. S. Preston. (*Trans. Inst. Radio Engrs*, Sept. 1955, Vol. EC-4, No. 3, pp. 101–106.) A modified Wheatstone-bridge arrangement is described, permitting computation of the tangents of angles between 0° and 90°. Only linear elements are used. The accuracy achieved is within 1 part in 2 500. The design of plug-in units is discussed.

681.142 **2970**

Design of Diode Function Simulators.—A. D. Talantsev. (*Avtomatika i Telemekhanika*, Feb. 1956, Vol. 17, No. 2, pp. 129–139.)

681.142 : 061.3 **2971**

Digital Computer Techniques.—D. B. G. Edwards. (*Nature, Lond.*, 9th June 1956, Vol. 177, No. 4519, pp. 1069–1071.) Brief report of a convention held at the Institution of Electrical Engineers, London, in April 1956. 58 papers were presented; the full text, together with reports of the discussion, is to be published in three sections as a supplement to *Proc. Instn elect. Engrs*, Part B.

681.142 : 621.374.3 **2972**

A Variable Multiple Pulse-Stream Generator.—W. Woods-Hill. (*Electronic Engng*, July 1956, Vol. 28, No. 341, pp. 306–307.) Apparatus designed for checking the logic of electronic computer circuits which require numerous pulse streams for their operation is described. The electrostatic pickup described previously (1632 of June) is used.

681.142 : 621.384.612 **2973**

Analog Computer for the Differential Equation $y'' + f(x)y + g(x) = 0$.—E. Bodenstedt. (*Rev. sci. Instrum.*, April 1956, Vol. 27, No. 4, pp. 218–221.) A high-precision electromechanical system developed from that mentioned previously (830 of 1955) uses a torsion pendulum whose motion corresponds to the given expression; the solutions are obtained from photographic records of the motion.

681.142 : 621.385.132 **2974**

Binary Adder uses Gas-Discharge Triode.—Maynard. (See 3261.)

681.142.002.2 **2975**

Pulse Circuits fabricate Computer Code Disk.—E. M. Jones. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 146–149.) "Frequency divider, counter, gate and wave-shaping circuits control optical circle-dividing machine to produce 16-bit pattern on photosensitive glass disk. Used for analog-to-digital conversion, the code disk has a pattern accuracy of ±0·0001 inch and can be made in about 2 hours." For another account, see *Proc. nat. Electronics Conf., Chicago*, 1955, Vol. 11, pp. 288–299 (Jones et al.).

681.142 **2976**

An Introduction to Electronic Analogue Computers. [Book Review]—C. A. A. Wass. Publishers: Pergamon Press, London, 1955, 237 pp., 40s. (*Brit. J. appl. Phys.*, April 1956, Vol. 7, No. 4, p. 157.)

CIRCUITS AND CIRCUIT ELEMENTS

621.3.018.3 **2977**

An Experimental Investigation of Subharmonic Oscillations in a Nonlinear System.—K. Göransson & L. Hansson. (*Kungl. tek. Högsk. Handl., Stockholm*, 1956, No. 97, 16 pp. In English.) Forced subharmonic oscillations in a circuit containing an iron core are studied. Damping is reduced by means of feedback, so that measurements can be effected at very low driving voltages and subharmonics up to the ninth. Results are in good agreement with theory developed by Lundquist (1269 of May) for low driving voltages.

621.316.8 : 621.372.44 : 621.314.26 **2978**

Frequency Conversion with Positive Nonlinear Resistors.—C. H. Page. (*J. Res. nat. Bur. Stand.*, April 1956, Vol. 56, No. 4, pp. 179–182.) Positive nonlinear resistors are defined as two-terminal devices through which the current I is a real finite single-valued nondecreasing function of the voltage V across the terminals, with the added condition that $I(0) = 0$. When subjected to an almost periodic voltage such a resistor will absorb power at some frequencies and supply power at other frequencies. Analysis indicates that modulation efficiency cannot exceed unity, that subharmonics are not produced, and that the efficiency of generating an nth harmonic cannot exceed $1/n^2$.

621.318.4 **2979**

Winding Focus Coils with Aluminium Foil.—(*Electronics*, July 1956, Vol. 29, No. 7, pp. 244..252.) Coils of Al foil with a thin coating of Al oxide are wound with no additional insulation.

621.319.4 : 621.315.615.9 **2980**

Polychloronaphthalene-Impregnated-Paper Capacitors.—J. Coquillion. (*Rev. gén. Élect.*, March 1956, Vol. 65, No. 3, pp. 185–193.) Polychloronaphthalene waxes are particularly suitable for use as impregnants in paper-dielectric capacitors, having stable characteristics at temperatures as high as 110°C or over. In certain cases an aging effect is avoided by allowing the wax to cool from the liquid to the solid state under the influence of an a.c. or d.c. field. This phenomenon is discussed in relation to the dipole nature of the waxes.

621.319.4 : 621.317.3 : 681.142 **2981**

Industrial Measurement of the Temperature Coefficient of Ceramic-Dielectric Capacitors.—Peyssou & Ladefroux. (See 3136.)

621.319.45 **2982**

Tantalum Solid Electrolytic Capacitors.—D. A. McLean & F. S. Power. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 872–878.) A capacitor with low volume/capacitance ratio is obtained by forming a layer of Ta_2O_5 on a porous Ta anode and then depositing a number of coatings of MnO_2 to form a solid electrolyte. The unit is further coated with graphite, and a layer of Pb-Sn alloy is sprayed on to form the cathode. Temperature, frequency and life characteristics are reported.

621.372 **2983**

Inter-reciprocity applied to Electrical Networks.—J. L. Bordewijk. (*Appl. sci. Res.*, 1956, Vol. B6, Nos. 1/2, pp. 1–74.) A new concept, 'inter-reciprocity', is introduced which is useful in the study of nonreciprocal networks. When a particular topological operation termed 'transposition' is performed on a given linear network, the initial network and the resulting transposed network are said to be inter-reciprocal. Application of the theory to a variety of general and special circuit problems is illustrated; the noise properties of gyrator, triode and transistor networks are discussed.

621.372 : 621.3.018.752 : 621.397.8 **2984**

The Effect upon Pulse Response of Delay Variation at Low and Middle Frequencies.—M. V. Callendar. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 475–478.) "Calculations are given for the magnitude and form of the distortion introduced into a square wave by a network or system which exhibits uniform transmission except for increasing (or decreasing) phase delay in the low-mid-frequency region. The fractional peak distortion is found to be equal to twice the area under the curve relating T_n to frequency,

where T_a is the delay relative to that at high frequencies. The waveform of the distortion is given for several simple shapes of curve for T_a. This distortion is especially characteristic of vestigial-sidcband systems, and occurs in television as a 'pre-shoot' before a transition and as a smear (in principle equal, but opposite, to the pre-shoot) after it."

621.372.012 **2985**

Feedback Theory—Further Properties of Signal Flow Graphs.—S. J. Mason. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 920–926.) Continuation of theory presented previously (3531 of 1953).

621.372.41 : 621.318.424 **2986**

Transient Behavior in a Ferroresonant Circuit.—J. G. Skalnik. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 508–513.) An analysis is made of the response to a sinusoidal voltage of a circuit including a nonlinear inductor. For certain frequency values of the applied voltage there are three possible values for the flux in the inductor, of which the middle value is unstable. The differential equation representing the circuit has been solved using an analogue computer. For the case when the system is released in the region of the lower stable state, the solution corresponds to two sinusoidal oscillations of different amplitude and frequency. If the system is released in the region of the upper stable state, the solution corresponds to an oscillation modulated in amplitude and phase, for certain values of the parameters.

621.372.413 : 621.317.337 **2987**

Measurement of the *Q*-Factor of Cavity Resonators, using a Straight Test Line.—Urbarz. (See 3141.)

621.372.44 : 621.372.6 **2988**

Some General Properties of Nonlinear Elements: Part 1—General Energy Relations.—J. M. Manley & H. E. Rowe. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 904–913.) An analysis is made of power relations in networks with reactive nonlinear elements. Two equations are derived relating the powers at different frequencies; the only assumption introduced is that the nonlinear characteristic is single-valued. The theory is relevant to the operation of modulators, demodulators and harmonic generators.

621.372.5(083.5) **2989**

Tables of Phase of a Semi-infinite Unit Attenuation Slope.—D. E. Thomas. (*Bell Syst. tech. J.*, May 1956, Vol. 35, No. 3, pp. 747–749.) The five-figure tables published previously (968 of 1948) are to appear together with newly prepared seven-figure tables as *Bell System Monograph* 2550.

621.372.51 : 621.372.22 **2990**

Fundamentals in the Synthesis of Loss-Free Quadripoles from Lines with Continuous Non-uniformities.—H. Meinke. (*Nachrichtentech. Z.*, March 1956, Vol. 9, No. 3, pp. 99–106.) The synthesis is facilitated by appropriate choice of line coordinates and a polynomial representation of the characteristic impedance. Application to problems of wide-band transformation and matching are illustrated.

621.372.51 : 621.396.67 **2991**

Impedance Quadripoles for the Frequency Compensation of Aerial Input Impedance.—R. Herz. (*Nachrichtentech. Z.*, March 1956, Vol. 9, No. 3, pp. 128–133.) Networks with one or two frequency-independent resistances are discussed which are capable of effecting wide-band matching with lower losses than reactive circuits at frequencies up to 1 kMc/s or above. Composite coaxial-line sections are used; in an application to a dipole aerial for use with a parabolic-cylinder reflector, the compensating coaxial line serves as support for the dipole.

621.372.54 : 621.375.132 : 621.3.018.75 **2992**

Normalized Representation of Transients in Filter Amplifiers with Double-T Elements.—H. Dobesch. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1956, Vol. 64, No. 4, pp. 102–107.) The response of amplifiers with frequency-dependent negative feedback is analysed for various pulse and step waveforms; the frequency spectrum corresponding to a train of square pulses is determined.

621.372.542.2 **2993**

A Solution to the Approximation Problem for *RC* Low-Pass Filters.—K. L. Su & B. J. Dasher. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 914–920.) A method of synthesizing filters is described in which elliptic functions are used to effect a transformation in the complex-frequency plane which results in a symmetrical arrangement of the zeros and poles. Some design charts are included.

621.372.57 : [621.385 + 621.314.7 **2994**

A Particular Case of the Application of the Matrix Method to Radio Engineering.—B. Ya. Yurkov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1988–1993.) Use of the matrix method in analysis of the operation of quadripoles including thermionic valves or transistors is discussed. A simple method is proposed for carrying out the necessary transformations to the formulae on passing from the one case to the other.

621.373 + 621.375.9] : 538.561.029.6 **2995**

Application of Electron Spin Resonance in a Microwave Oscillator or Amplifier.—Combrisson, Honig & Townes. (See 3032.)

621.373.421 **2996**

Constant-Frequency Oscillators.—L. B. Lukaszewicz. (*Wireless Engr*, Aug. 1956, Vol. 33, No. 8, pp. 201–202.) Comment on 697 of March (Gladwin).

621.373.421 **2997**

Bridge-Stabilized Oscillators and their Derivatives.—E. J. Post & J. W. A. van der Scheer. (*J. Brit. Instn Radio Engrs*, June 1956, Vol. 16, No. 6, pp. 345–350.) Reprinted from *PTT-Bedrijf*, Sept. 1955, Vol. 6, No. 4. General analysis is presented for the operation of the bridge-stabilized feedback oscillator, and modifications obtained by interchanging bridge elements crosswise or by unbalancing the bridge are discussed.

621.373.421.13 : 621.372.412 : 621.316.726 **2998**

Frequency Stability and Quartz-Controlled Oscillators.—A. Erkens. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 399–405.) The operation of some commonly used types of crystal-controlled oscillator is reviewed. Frequency can be held constant to within a factor of 10^{-8} over a period of months by using a Y-bar crystal resonator.

621.373.431.1 **2999**

Bistable Circuits using Triode-Pentodes.—H. L. Armstrong. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 210..214.) Note on the operation of multivibrator-type circuits in which one feedback path is provided by connecting triode anode to pentode screen, leaving one grid free for triggering, gating or modulation.

621.373.432 **3000**

Simple Method for producing H.F. Pulses of Short Duration and Large Amplitude.—A. V. J. Martin. (*J. Phys. Radium*, March 1956, Vol. 17, No. 3, p. 310.) Pulses of duration about 10 μs and peak-to-peak amplitude about 240 V are obtained from the tuned secondary of a transformer in the cathode circuit of a thyratron.

621.373.52 + 621.375.4] : 621.314.7 **3001**

Applications for Tandem Transistors.—H. E. Hollmann. (*Tele-Tech & Electronic Ind.*, Feb. 1956, Vol. 15, No. 2, pp. 58–59, 114.) The tandem transistor, consisting of two transistors housed in a single container and cascaded so that one acts as the base leak for the next, may be used as an amplifier with high input impedance and in various applications in which single grounded-emitter stages are normally used.

621.373.52.029.3 **3002**

Superregenerative Transistor Oscillator.—R. J. Kircher & I. P. Kaminow. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 166–167.) The circuit described generates pulses of 500-c/s tone at a rate of 7/sec. The performance with different values of quench capacitor, bias, feedback, etc. is shown graphically.

621.374 **3003**

Investigation of Special Frequency Dividers with Large Dividing Ratio.—E. O. Philipp. (*Z. angew. Phys.*, March 1956, Vol. 8, No. 3, pp. 119–126.) Two frequency dividers and one pulse counter are developed on the basis of Kroebel's work (383 of 1955). These give stable dividing ratios of 100 and 200 at input pulse frequencies of 4 Mc/s and 31·25 kc/s respectively. The counter can handle irregular pulses spaced at intervals of 1–50 ms.

621.374.3 : 621.385.5.032.24 **3004**

A New High-Slope Multigrid Valve and its Application in Pulse and Switching Circuits.—Gosslau & Guber. (See 3262.)

621.374.32 : 621.314.7 **3005**

A Point-Contact Transistor Scaling Circuit with 0·4-μs Resolution.—G. B. B. Chaplin. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 505–509. Discussion, pp. 516–518.) Simple circuits using normal point-contact transistors are described; features contributing to the short resolving time are the prevention of bottoming of collector potential and the absence of capacitors. A typical scale-of-ten circuit uses seven transistors, seven pulse transformers and 14 crystal diodes. Wide tolerances on the transistor parameters are permissible.

621.374.32 : 621.314.7 **3006**

A Junction-Transistor Scaling Circuit with 2-μs Resolution.—G. B. B. Chaplin & A. R. Owens. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 510–515. Discussion, pp. 516–518.) The basic circuit discussed is a binary scaler using a differentiating transformer instead of capacitors for coupling; the speed of operation thus depends only on the transistor characteristics. Scale-of-5 and scale-of-10 circuits built up from the basic circuit are described.

621.375.2 : 621.385.3.029.63 **3007**

Disc-Seal Triode Amplifiers.—G. Craven. (*Wireless Engr*, Aug. 1956, Vol. 33, No. 8, pp. 179–183.) "The design of a resonant π-type coupling network for disc-seal triodes operating in the earthed-grid connection at frequencies in the range 300–3 000 Mc/s is considered. A coaxial form of line is adopted. Tuning for a small range can be by a 'screw' or, for a larger range, by a built-in capacitance. Complete amplifiers can give 100-W output and 30-dB gain using three stages."

621.375.2 : 621.385.5 : 621.314.7 **3008**

Higher Pentode Gain.—L. Levy. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 190, 196.) Note on the use of a transistor as an anode load.

621.375.232.029.3 : 621.396.822 **3009**

Noise in an Amplifier Stage with Negative Voltage Feedback.—H. Nottebohm. (*Elektronische Rundschau*, March 1956, Vol. 10, No. 3, pp. 57–62.) The problem is considered with particular reference to the input circuit of an amplifier for a magnetic tape recorder. Analysis indicates that frequency distortion inherent in the system can be corrected by use of negative feedback at the input valve, and indicates the existence of an optimum ratio for the input transformer, from the point of view of signal/noise ratio.

621.375.232.3.029.3 **3010**

Triode Cathode-Followers for Impedance Matching to Transformers and Filters.—T. J. Schultz. (*Trans. Inst. Radio Engrs*, March/April 1955, Vol. AU-3, No. 2, pp. 28–37.) Design curves derived from measurements on five different types of triode are presented.

621.375.232.9 **3011**

An Improved Type of Differential Amplifier.—J. C. S. Richards. (*Electronic Engng*, July 1956, Vol. 28, No. 341, pp. 302–305.) "A differential amplifier stage capable of giving a high rejection ratio with unselected valves and components and without a balance control is analysed, and a particular amplifier is described in some detail. The stage is particularly suitable for converting balanced to unbalanced signals."

621.375.3 **3012**

Comparison of some Magnetic-Amplifier Circuits with Internal Feedback.—A. B. Gorodetski. (*Avtomatika i Telemekhanika*, Feb. 1956, Vol. 17, No. 2, pp. 147–159.)

621.375.3 **3013**

Push-Pull Magnetic Amplifier with Direct-Current Output.—R. Kh. Bal'yan. (*Avtomatika i Telemekhanika*, Feb. 1956, Vol. 17, No. 2, pp. 160–171.)

621.375.3 : 621-526 **3014**

Decicycle Magnetic-Amplifier Systems for Servos.—L. J. Johnson & S. E. Rauch. (*Elect. Engng, N.Y.*, March 1956, Vol. 75, No. 3, p. 243.) Digest of paper published in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, 1955, Vol. 74, pp. 667–672. Improvements in circuitry and core materials, and the adoption of pulse techniques, make possible systems whose response times are one tenth to one hundredth of a cycle of the power-supply frequency.

621.376.22 : 621.318.134 **3015**

A Ferrite Microwave Modulator employing Feedback.—W. W. H. Clarke, W. M. Searle & F. T. Vail. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 485–490.) An amplitude modulator with good linearity is obtained by applying feedback to a gyrator comprising a ferrite rod in a circular waveguide section interposed between rectangular waveguide sections. The feedback circuit is based on linear detection of the amplitude modulation by means of a crystal. Limitations of the arrangement are discussed. Good results have been obtained with sinusoidal modulating signals of frequencies up to 20 kc/s.

621.37/.39(083.74) **3016**

Handbook Preferred Circuits, Navy Aeronautical Equipment, NAVAER 16-1-519. [Book Review]—J. C. Muncy. Publishers: Government Printing Office, Washington, $1.75. (*Tech. News Bull. nat. Bur. Stand.*, May 1956, Vol. 40, No. 5, pp. 66–67.) Gives design details and characteristics of the standardized circuits discussed previously (342 of February). Supplements are to be issued from time to time.

621.375.13 **3017**

Linear Feedback Analysis. [Book Review]—J. G. Thomason. Publishers: Pergamon Press, London, 365 pp., 55s. (*J. Instn elect. Engrs*, March 1956, Vol. 2, No. 15, p. 187). A useful introduction to the subject.

GENERAL PHYSICS

537 : 538.56 **3018**

Electron Plasma Oscillations in an External Electric Field.—A. I. Akhiezer & A. G. Sitenko. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 216–218.) The oscillation frequency is calculated, assuming that the electron distribution function satisfies a given kinetic equation.

537.2 **3019**

Fields and Stresses in Dielectric Media.—G. Power. (*Brit. J. appl. Phys.*, April 1956, Vol. 7, No. 4, pp. 137–144.) Expressions are obtained for the mechanical forces at the boundary of an isotropic dielectric, caused by an electric field. Results are verified in particular cases by electrolyte-tank experiments.

537.311.1 **3020**

On the Energy Dissipation of Conduction Electrons undergoing Elastic Scattering by Impurities.—T. Yamamoto, K. Tani & K. Okada. (*Progr. theor. Phys.*, Feb. 1956, Vol. 15, No. 2, pp. 184–185.) A brief theoretical note on the mechanism responsible for the energy dissipation in conduction in metals.

537.311.31 : 537.312.8 **3021**

Theory of Galvanomagnetic Phenomena in Metals.—I. M. Lifshits, M. Ya. Azbel' & M. I. Kaganov. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 220–222.) The theory is developed without making any special assumptions regarding the conduction-electron dispersion law and the form of the collision integral.

537.311.62 **3022**

Anomalous Skin Effect assuming Arbitrary Collision Integral.—M. Ya. Azbel' & E. A. Kaner. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 876–878.) Results of a calculation of the surface impedance $Z_\alpha = R_\alpha + iX_\alpha$, show that the ratio X_α/R_α equals $\sqrt{3}$ for an arbitrary electron-dispersion law and an arbitrary collision integral; Z_α is proportional to $\omega^{2/3}$ and is independent of temperature in the anomalous-skin-effect temperature range.

537.5 **3023**

Statistics of Electron Avalanches in a Uniform Field.—L. Frommhold. (*Z. Phys.*, 7th Feb. 1956, Vol. 144, No. 4, pp. 396–410.) The statistical distribution of the number of charge-carrier pairs about the mean was determined experimentally by measurements on discharges in ethyl alcohol. Results agree with theory.

537.523 **3024**

Surge Voltage Breakdown of Air in a Non-uniform Field.—J. H. Park & H. N. Cones. (*J. Res. nat. Bur. Stand.*, April 1956, Vol. 56, No. 4, pp. 201–224.) Experiments on discharges between a spherical and a plane electrode are described, and a tentative explanation of the breakdown mechanism is presented.

537.525 : 538.56.029.5 **3025**

Investigation of a Discharge in the Frequency Region between High Frequency and Audio Frequency at Low Gas Pressure.—N. A. Popov & N. A. Kaptsov. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 68–76. English summary, *ibid.*, Supplement, p. 5.)

537.525 : 538.56.029.6 **3026**

Investigation of the High-Frequency Discharge.—G. M. Pateyuk. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 12–17. English summary, *ibid.*, Supplement, p. 3.) The dependence of the ignition and operating potentials in Ar, Ne and H_2 on the gas pressure and the geometry of the discharge space was investigated in the frequency range 57–500 Mc/s. Results, presented graphically, are in agreement with the diffusion theory of Herlin & Brown (690 of 1949).

537.533 **3027**

Influence of an Adsorbed Film of Dipole Molecules on the Electron Work Function of a Metal.—N. D. Morgulis & V. M. Gavrilyuk. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 149–159. English summary, *ibid.*, Supplement, p. 7.) Experimental results indicate that films of CsCl molecules decrease the work function of W by up to 1·8 eV, as compared with a decrease of up to 3 eV produced by Cs, 3·5 eV by BaO and 2·9 eV by Ba.

537.533.8 **3028**

Auger Electron Emission in the Energy Spectra of Secondary Electrons from Mo and W.—G. A. Harrower. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 340–347.) Analysis of the observed energy distributions of the secondary electrons for a range of primary energies reveals subsidiary maxima at points along the energy axis characteristic of the target material but independent of the primary voltage; the positions of these points are consistent with an Auger-process origin for the electrons with these energies.

537.533.8 : 546.561-31 **3029**

Investigation of the Inelastic Reflection of Electrons by a Cuprous Oxide Surface.—N. B. Gornyi. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 160–170. English summary, *ibid.*, Supplement, pp. 7–8.) The energy losses of electrons on reflection at monocrystalline or polycrystalline Cu_2O surfaces are equal to the energy required to transfer electrons of the crystal lattice from filled to permitted zones. The mechanism involved is similar to that responsible for the appearance of discrete groups of true secondary electrons (685 of 1955).

538.311 **3030**

Production and Use of High Transient Magnetic Fields: Part 1.—H. P. Furth & R. W. Waniek. (*Rev. sci. Instrum.*, April 1956, Vol. 27, No. 4, pp. 195–203.) Technique for the production of pulsed magnetic fields of strength 5×10^5 G or over is discussed; capacitor-discharge arrangements are used, with impact-resistant solenoids comprising massive single-layer helices. Pulse durations range from 50 μs to 10 ms. Measurement of the magnetoresistance of Ge is one of the applications mentioned.

538.56 : 53 **3031**

Radio-Frequency Physics.—J. G. Powles. (*Nature, Lond.*, 2nd June 1956, Vol. 177, No. 4518, pp. 1022–1023.) Brief report of the 1956 annual conference, held at Geneva, of the organization A.M.P.É.R.E. (Atomes et Molécules par Études Radioélectriques), which is concerned with the use of radio frequencies in the various branches of physics. Some 50 papers were presented, the subjects including dielectric and magnetic properties, electron resonance of various types and associated effects, and microwave spectroscopy. See also *Onde élect.*, May 1955, Vol. 35, No. 338, pp. 437–505, which gives papers from the 1954 conference, held at Paris, covering a similar range of subjects and including also some material on atmospheric physics.

538.561.029.6 : [621.373 + 621.375.9 **3032**

Application of Electron Spin Resonance in a Microwave Oscillator or Amplifier.—J. Combrisson, A. Honig & C. H. Townes. (*C. R. Acad. Sci., Paris*, 14th May 1956, Vol. 242, No. 20, pp. 2451–2453.) A brief analysis indicates the condition for a paramagnetic substance located within a cavity resonator and subjected to a direct magnetic field to supply power instead of absorbing it from the field. Results of preliminary experiments indicate that it should be possible to produce oscillations using e.g. a small sample of Si containing a suitable impurity providing a concentration of about 10^{17} paramagnetic centres per cm^3.

538.566 : 535.337 **3033**

Radiation from Molecules in the Presence of a Strong High-Frequency Field.—V. M. Fain. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 878–880.) It is shown that in addition to an absorption of the h.f. energy at a frequency $\omega \simeq \omega_0 = (E_1 - E_2)/h$, where E_1 and E_2 are energy levels of the molecule, emission takes place at a frequency Ω_0 which is a function of the matrix element $\vec{\mu}_{12}$ of the dipole moment corresponding to the transition $E_1 \rightarrow E_2$ and the field strength of the h.f. field. In a typical case $|\vec{\mu}_{12}| \simeq 10^{-18}$ e.g.s.e. and the field strength is 1–10 e.g.s.e.; the value of Ω_0 is then approximately 10^9 $sec^{-1} - 10^{10}$ sec^{-1}. The radiation is only present if the elements $\vec{\mu}_{11}$ and $\vec{\mu}_{22}$ are not equal to zero.

538.566 : 535.42] + 534.24 **3034**

Fourier Transform Method for the Treatment of the Problem of the Reflection of Radiation from Irregular Surfaces.—W. C. Meecham. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 370–377.)

538.566 : 537.533.9 **3035**

Incidence of an Electromagnetic Wave on a 'Čerenkov Electron Gas'.—M. A. Lampert. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 299–304.) Analysis is presented for the interaction of an e.m. wave in a retarding medium (e.g. a dielectric) with an electron gas moving through or near the medium at a velocity exceeding that of the wave in the medium. For electron densities exceeding a critical value, the gas acts as a mirror for the incident e.m. wave. Possible laboratory experiments for investigating the problem are outlined.

538.566.2 **3036**

Method of calculating Electromagnetic Fields excited by an Alternating Current in Stratified Media.—A. N. Tikhonov & D. N. Shakhsuvarov. (*Bull. Acad. Sci. U.R.S.S., sér. géophys.*, March 1956, No. 3, pp. 245–251. In Russian.) The expressions for the field due to a dipole in the boundary of a stratified half-space are developed in a form suitable for evaluation by a modern computer. The e.m. characteristics of the strata are assumed to be independent of time and of the field; the permeability is constant and the conductivities are arbitrary; the conductivity of the surface layer is finite.

538.569.2/.3].029.6 : 534.833.4 **3037**

Absorption Devices for Centimetre Electromagnetic Waves and their Acoustic Analogues.—E. Meyer & H. Severin. (*Z. angew. Phys.*, March 1956, Vol. 8, No. 3, pp. 105–114.) A survey of the operating mechanism of three types of absorbers: (*a*) homogeneous material, (*b*) wedges, and (*c*) resonance absorbers.

538.6 : 537.311.31 **3038**

Thermo- and Galvano-magnetic Effects in Strong Fields at Low Temperatures.—G. E. Zil'berman. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 762–769.) Thermoelectric force, resistance and Hall effect of a metal in a magnetic field at low temperatures are calculated using a two-zone model of the metal.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **3039**

An Investigation of Monochromatic Radio Emission of Deuterium from the Galaxy.—G. J. Stanley & R. Price. (*Nature, Lond.*, 30th June 1956, Vol. 177, No. 4522, pp. 1221–1222.)

525.2 : 523.2 **3040**

Gravitational Influence of Jupiter on some Geophysical Phenomena.—D. Argentieri. (*Ann. Geofis.*, Oct. 1955, Vol. 8, No. 4, pp. 457–473.) Consideration of astronomical observations from ancient times onwards has indicated apparent variations in astronomical time. Attention is drawn particularly to a variation having a period of 83 years; this is also the period taken by the sun, the earth and Jupiter to return to the same alignment and relative distance. It is suggested that the combined gravitational action of the sun and Jupiter causes tidal motion in the earth's crust, the apparent variation of astronomical time corresponding to a real displacement of the meridian.

551.510.5 : 538.569.4.029.6 : 523.72 **3041**

Atmospheric Attenuation of Solar Millimeter-Wave Radiation.—H. H. Theissing & P. J. Caplan. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 538–543.) Measurements have been made of the absorption of solar radiation by atmospheric water vapour at wavelengths down to about 1 mm. The results are combined with theoretical formulae for the absorption spectrum of water vapour [see e.g. 3100 of 1947 (Van Vleck)].

551.510.53 : 551.593 **3042**

Origin of the Meinel Hydroxyl System in the Night Airglow.—D. R. Bates & B. L. Moiseiwitsch. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 305–308.)

551.510.53 : 551.593 + 551.594.5] : 535.241 **3043**

A Photometric Unit for the Airglow and Aurora.—D. M. Hunten, F. E. Roach & J. W. Chamberlain. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 345–346.)

551.510.534 **3044**

Note on the Variations of Atmospheric Ozone as a Function of Height.—E. S. Epstein, C. Osterberg & A. Adel. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 347–348.) Observations confirming those of Paetzold (748 of March) are reported.

551.510.535 **3045**

Symposium on Ionospheric Drifts.—(*J. sci. industr. Res.*, Oct. 1955, Vol. 14A, No. 10, pp. 482–485.) Brief report of symposium held at New Delhi in July 1955.

551.510.535 **3046**

Accurate Height Measurements using an Ionospheric Recorder.—A. J. Lyon & A. J. G. Moorat. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 309–317.) "A method for the calibration of an ionospheric recorder is described, which corrects errors in height measurement arising from the distortion of the echo-pulse in its passage through the receiver. The amount of this error depends on the echo amplitude, and is shown to vary in an approximately linear manner with the width of the recorded echo trace. Several methods of checking the calibration confirm that it is reliable to within ± 2 km. Using a calibrated recorder and an expanded timebase, it is possible to measure E-region equivalent heights to this order of accuracy. The systematic error due to pulse distortion will, in general, cause the heights recorded in routine ionospheric measurements to be from 5 to 15 km too high. Some consequences of this, e.g. for m.u.f. predictions, are mentioned."

551.510.535 **3047**

Monthly Mean Values of Ionospheric Characteristics at Rome in the Period March 1949–April 1953.—P. Dominici. (*Ann. Geofis.*, Oct. 1955, Vol. 8, No. 4, pp. 379–400.) Hourly values are tabulated for the critical frequency and virtual height of the F_2, F_1 and E layers and for the percentage of occurrences of the E_s layer. Brief particulars are given of the sounding schedule operated and the conventions adopted in the calculations.

551.510.535 **3048**

Sporadic Echoes from the E Region over Ahmedabad (23° 02′ N, 72° 38′ E).—K. M. Kotadia. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 331–337.) An analysis is made of *h′f* records for the sunspot-minimum period 1953–1954. The diurnal and seasonal variations of E_s as a whole are interpreted as variations in the relative contributions of three distinct types of E_s, namely (*a*) E_{ss}, a thin layer observed at 95–100 km, with a maximum frequency of occurrence at late evening, (*b*) E_{sm}, which is observed at 105–125 km with a minimum in the afternoon and maximum towards the end of the night, and (*c*) E_{sl}, at 115–125 km, developed by the vertical downward movement of the E_2 layer and observed only during the daytime.

551.510.535 **3049**

A New Theory of Formation of the F_2 Layer.—T. Yonezawa. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 1–16.) Electron/ion pairs generated in the upper part of the F_2 region diffuse rapidly downwards under gravity, but at sufficiently low heights they are rapidly lost by the mechanism of charge transfer and dissociative recombination suggested by Bates & Massey (1944 of 1948), giving rise to a maximum ionization density at a greater height. This theory gives results in accordance with observations.

551.510.535 **3050**

The Structure of the F_2 Layer as deduced from its Daily Variations.—T. Shimazaki. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 17–43.) Observed variations in the F_2 region may be accounted for by assuming that (*a*) in consequence of the decrease with height of the effective decay coefficient, the maximum electron density in the F_2 region is at a level above that of maximum electron production, and that (*b*) vertical semidiurnal tidal drift is nonuniform. At the level of maximum electron production the rate of production varies inversely as temperature. An attachment coefficient of $8{\cdot}3 \times 10^{-5}$/sec at 300 km is indicated, with a solar temperature of 6 000° K.

551.510.535 **3051**

Geomagnetic Control to the Diurnal Variation of the F_2 Layer on the Temperate Latitude.—Syun-ichi Akasofu. (*Sci. Rep. Tohoku Univ., 5th Ser., Geophys.*, Nov. 1955, Vol. 7, No. 2, pp. 45–50.) The 'longitude effect' demonstrated by Appleton (882 of 1951) is examined. The observed diurnal variation is consistent with geomagnetic control of the thermal vertical flow in the F_2 region. Seasonal variations are also observed.

551.510.535 : 523.746.5 **3052**

Comparison of f_0F_2 at Four Observatories in Japan.—I. Kasuya & K. Sawada. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 45–53.) Observations over the solar-activity half-cycle 1947–1954 are correlated with sunspot numbers. On a long-term basis, the magnitude of the variation of f_0F_2 is a function of latitude.

551.510.535 : 537.56 **3053**

Negative Oxygen Ions in the Upper Atmosphere: the Affinity and Radiative Attachment Coefficient of Atomic Oxygen.—L. M. Branscomb & S. J. Smith. (*Trans. Amer. geophys. Union*, Oct. 1955, Vol. 36, No. 5, pp. 755–758.) "The influence of negative ions of atomic oxygen on the physics of the ionosphere and night airglow is re-examined in the light of new experimental determinations of the oxygen affinity ($1{\cdot}48 \pm 0{\cdot}10$ eV) and photodetachment cross section [396 of February (Smith & Branscomb)]. The radiative attachment coefficient is calculated from the photodetachment cross section. There is no evidence of a resonance at the threshold, where the attachment coefficient is approximately $1{\cdot}2 \times 10^{-15}$ cm³/sec."

551.510.535 : 621.396.11 **3054**

Observations of Ionospheric Absorption at the K.N.M.I. [Royal Netherlands Meteorological Institute].—C. J. van Daatselaar. (*Tijdschr. ned. Radiogenoot.*, March 1956, Vol. 21, No. 2, pp. 49–63.) Theory of ionospheric absorption is outlined and measurement difficulties due to fading are discussed. The procedure at the Netherlands station is to determine the apparent reflection coefficient for vertically incident waves, using pulse transmissions with c.r.o. display of the echo amplitude; total absorption and absorption index are hence derived. The equipment is described and some results are reported.

551.510.535 : 621.396.11 **3055**

On the Existence of a 'Q.L.'-'Q.T.' 'Transition-Level' in the Ionosphere and its Experimental Evidence and Effect.—D. Lepechinsky. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 297–304.) See 1767 of 1955 (Lepechinsky & Durand).

551.510.535 : 621.396.11.029.55 **3056**

Back-Scatter Ionospheric Sounder.—Shearman & Martin. (See 3197.)

551.510.535 : 621.396.812.3 **3057**

A Correlation Treatment of Fading Signals.—Barber. (See 3200.)

551.594.6 **3058**

On the Propagation of Whistling Atmospherics.—G. R. Ellis. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 338–344.) "It is shown that the dispersion of whistling atmospherics propagated along the lines of force of the earth's magnetic field should be greatly dependent on the geomagnetic latitude of the observing point. The change in the magnetic-field intensity along a line of force produces an upper-frequency limit for whistler propagation which, at latitudes greater than 62°, should fall within the usually observed frequency region of 1–10 kc/s. Dispersion curves showing this critical frequency are given for geomagnetic latitudes 55°, 60° and 65°."

551.594.6 : 523.75 **3059**

Sudden Decrease in Low-Frequency Atmospheric Noise during the Cosmic-Radiation Storm of February 23.—C. A. McKerrow. (*Nature, Lond.*, 30th June 1956, Vol. 177, No. 4522, pp. 1223–1224.) Note of observations on 100 kc/s at Churchill, Manitoba. The relation of the disturbance to solar-flare conditions and to the proximity of the station to the auroral zone is briefly discussed.

551.594.6 : 538.566.029.43 **3060**

Influence of the Horizontal Geomagnetic Field on Electric Waves between the Earth and the Ionosphere travelling Obliquely to the Meridian.—W. O. Schumann. (*Z. angew. Phys.*, March 1956, Vol. 8, No. 3, pp. 126–127.) A more general case than that noted earlier (232 of January) is considered briefly. Results indicate that the differences in the type of atmospherics waveform arriving from south-east and from south-west [2809 of 1952 (Caton & Pierce)] are due to differences not in the propagation but in the nature of the discharge, which may occur over the sea in one case, over land in the other.

551.594.6 : 550.385 **3061**

The Low-Frequency Noise of the Geomagnetic Field.—R. Benoit. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2534–2535.) Grenet's investigations of the source of a.f. disturbances (1718 of June) are discussed. Observations made in the Sahara are reported; a telephone cable formed into a circular loop of diameter 300 m was used as aerial, in conjunction with a multistage amplifier and pen recorder; the total frequency band explorable was 10 c/s–50 kc/s. The results indicate that the low-frequency pulses received are almost entirely due to atmospherics; this confirms Grenet's theory.

551.594.6 : 550.385 **3062**

Electromagnetic Phenomena of Natural Origin in the 1·0–150-c/s Band.—P. A. Goldberg. (*Nature, Lond.*, 30th June 1956, Vol. 177, No. 4522, pp. 1219–1220.) A report is presented of observations made at an isolated region in Oregon in the summer of 1955. Air-core detector coils were used, one with an effective area of 12 800 m² for observing the vertical magnetic-field component, and another with an effective area of 5 500 m² for the horizontal north-south component. Voltage waveforms proportional to the field and to its time rate of change were studied by means of photographic records from c.r. oscillographs. The signals recorded are predominantly of burst type, the horizontal component being more intense than the vertical. The level of activity exhibits a systematic diurnal variation. Comparison with the incidence of r.f. atmospherics suggests that the low-frequency signals are associated with lightning, while the timing of the daytime maximum indicates that the propagation mechanism is different from that for the r.f. atmospherics.

551.594.6 : 621.396.11 **3063**

The Propagation of a Radio Atmospheric.—Srivastava. (See 3189.)

551.594.6 : 621.396.11.029.4 **3064**

Propagation of Audio-Frequency Radio Waves to Great Distances.—Chapman & Macairo. (See 3192.)

LOCATION AND AIDS TO NAVIGATION

621.396.93 **3065**

Fluctuations in Continuous-Wave Radio Bearings at High Frequencies.—W. C. Bain. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, p. 560.) The investigation reported previously (3265 of 1955), covering the frequency band 6–20 Mc/s, is extended to cover the band 3–4 Mc/s. The results differ from those obtained previously in that the standard deviation in a group of observations is not correlated significantly with the value of τ_0.

621.396.93 **3066**

The 'Wullenwever' Long-Base Direction-Finding Installation.—H. Rindfleisch. (*Nachrichtentech. Z.*, March 1956, Vol. 9, No. 3, pp. 119–123.) This system was developed during the war and is described in *Radio Research Special Report*, No. 21, 1951, *Radio Direction Finding and Navigational Aids; some Reports on German Work issued in* 1944–45.

621.396.96 : 519.21 : 621.396.822 **3067**

Connection between the Detectability of an Object and the Number of Illuminating Pulses.—G. N. Bystrov. (*Radiotekhnika, Moscow*, Feb. 1956, Vol. 11, No. 2, pp. 74–76.) The probability P, that a blip on the c.r. tube display is due to the object and not to the noise is $P = 1 - \exp.(-na_s^2/2a_0^2)$, where n is the number of radar pulses, a_s the amplitude of the blip, and a_0 the mean effective noise voltage. A Rayleigh-type noise-voltage amplitude distribution in the output of the second detector is assumed. The probability of detecting an object is then calculated in terms of the distance, transmitter power, aerial gain, wavelength, surface area of object and power input to receiver, as well as the absolute temperature, pass band and receiver noise factor.

621.396.96 : 621.316.726 : 621.385.029.6 **3068**

Klystron Control System.—R. J. D. Reeves. (*Wireless Engr*, June–Aug. 1956, Vol. 33, Nos. 6–8, pp. 135–143, 162–167 & 184–189.) Wide-range tuning of reflex klystrons is discussed with particular reference to an a.f.c. system for primary radar. The problem is complicated because the optimum reflector voltage is not independent of the resonator frequency. The concept of a 'control plane' is introduced to facilitate analysis of the klystron operation. Test equipment is described which presents the control plane on a c.r.o. and maps either klystron mode areas and frequency contours or servo-trajectories on to the plane. In the particular a.f.c. system described in detail, a sampling technique for mode centring is introduced which causes minimum disturbance of the controls and provides a slightly better error criterion than mode peak finding.

621.396.962.2 : 621.376.3 : 629.13 **3069**

A Frequency-Modulation Radio Altimeter.—G. Collette & R. Labrousse. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 387–398.) The Type-AM.210 altimeter is discussed; the range is 1 500 m and the frequency band 420–460 Mc/s; the modulating function is a symmetrical sawtooth repeated 4 050 or 810 times per min. The problem of coupling between the slotted-cavity aerials is examined, and suitable values of aerial spacing and feeder length are indicated.

621.396.963.001.4 : 534.21-8 **3070**

Variable Delay Line simulates Radar Targets.—S. A. Gitlin. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 143–145.) "Two quartz transducers and movable corner reflector in 3½-ft water-filled copper tank give time delays ranging from 72 to 1 400 μs for simulating moving targets during tests of new radar."

621.396.963.33.001.4 **3071**

Three-Dimensional Radar Video Simulator.—P. Pielich. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 131–133.) Terrain is represented on a test slide with six contour lines defining range and azimuth at six heights. The slide is scanned by a flying-spot system and x, y, z voltages from the simulator unit are combined to give appropriate X, Y deflection voltages for a c.r.o. Detailed circuit diagrams are given.

621.396.969 **3072**

Frequency-Modulation Radar for Use in the Mercantile Marine.—D. N. Keep. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 519–523. Discussion, pp. 523–526.) "The principles of f.m. radar are outlined and a comparison is made between pulse and f.m. techniques, particularly with respect to the requirements of the merchant service. It is concluded that multi-gate f.m. radars are too complex for this application and methods are outlined for overcoming the inherently low scanning rate of single sweeping-gate systems. Equipment is described which has an aerial beamwidth of 1·7° and a rotation rate of 10 r.p.m. with a fractional range resolution of 1/30. The future of f.m. radar for mercantile marine use is critically examined, the conclusion being that it will be most useful where very-short-range high-resolution pictures are required. Before such equipment is economically available further developments in transmitting valves must take place."

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **3073**

Observations on the Characteristics of the Cold-Cathode Ionization Gauge.—J. H. Leck & A. Riddoch. (*Brit. J. appl. Phys.*, April 1956, Vol. 7, No. 4, pp. 153–155.) A gauge of the type described by Penning & Nienhuis (1423 of 1950) has been calibrated for the pressure range 10^{-5}–10^{-2} mm Hg. Anode-cathode-voltage/current and pressure/current characteristics are given; in the latter a sharp discontinuity occurs at a pressure of about 10^{-3} mm Hg. A marked change in sensitivity occurs during the first 200 hours of operation; this may account for conflicting characteristics obtained by various workers.

533.56 **3074**

The Ultimate Vacuum Obtainable in Vapour Pumps.—N. A. Florescu. (*Vacuum*, Jan. 1954, Vol. 4, No. 1, pp. 30–39.) Experiments with hydrogen are described; the results indicate that in a well designed vapour pump the ultimate vacuum is limited not by the pressure of the gas diffused from the fore-pressure side but by the lowest total pressure of all gases and vapours leaving the nozzle, apart from the partial pressure of the vapour of the working fluid.

533.56 **3075**

Theory of Molecular Pumps at Very Low Pressures.—C. Mercier. (*J. Phys. Radium*, March 1956, Vol. 17, Supplement to No. 3, *Phys. appl.*, pp. 1A–11A.)

535.215 + 535.37 **3076**

A Theoretical Property of Relaxation Curves of Luminescence and Photoconductivity.—N. A. Tolstoi & A. V. Shatilov. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 109–114. English summary, *ibid.*, Supplement, p. 6.) A note on the recombination mechanism of phosphors and photoconductors.

535.215 : 546.817.221 **3077**

A Photo-E.M.F. dependent on Direction of Illumination in Polycrystalline PbS Films.—G. Schwabe. (*Ann. Phys., Lpz.*, 29th Feb. 1956, Vol. 17, Nos. 4/5, pp. 249–262.) Fuller account of work described previously (3271 of 1955).

535.215 : [546.863.221 + 546.23 **3078**

Time-Lag in Photoconductors for Camera Tubes.—W. R. Daniels. (*J. Instn elect. Engrs*, March 1956, Vol. 2, No. 15, pp. 150–151.) A brief note on preliminary observations of the time lag in amorphous Se and Sb_2S_3.

535.37 : 546.472.21 **3079**

Reduction of the Luminous Output of Phosphors under Intense Excitation.—V. V. Antonov-Romanovski & L. A. Vinokurov. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 830–833.) Measurements on ZnS-Cu,Co, and comparison with earlier measurements on ZnS-Cu, indicate that the observed effect is due to an increase of the concentration of localized electrons and ionized luminescence centres resulting in an increase of the number of radiationless recombinations.

535.37 : 546.472.21 **3080**

Phosphorescence of ZnS-Cu Crystal Phosphor excited by an Electron Beam.—T. P. Belikova. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 905–906.) Luminescence decay curves of a ZnS-Cu specimen excited by radiation of wavelength 365 mμ and by an electron beam (2 000 V, up to 3 μA/cm²) are compared. The initial-intensity/temperature curves are also given.

535.376 **3081**

Electroluminescence from Boron Nitride.—S. Larach & R. E. Shrader. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, p. 582.) A preliminary note reporting observations of electroluminescence with alternating-field excitation, using an electrode isolated from the phosphor.

537.226 + 537.228.1] : 546.431.824-31 **3082**

Elastic, Piezoelectric, and Dielectric Constants of Polarized Barium Titanate Ceramics and some Applications of the Piezoelectric Equations.—R. Bechmann. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 347–350.) A complete set of the constants and the various electromechanical coupling factors is given and typical values are tabulated.

537.228.1 : 549.514.51 **3083**

Piezoelectric Structure of Quartz and of Minerals containing Quartz.—E. I. Parkhomenko. (*Bull. Acad. Sci. U.R.S.S., sér. géophys.*, March 1956, No. 3, pp. 297–306. In Russian.)

537.311.31 : 539.23 **3084**

The Electrical Conductivity of Anisotropic Thin Films.—R. Englman & E. H. Sondheimer. (*Proc. phys. Soc.*, 1st April 1956, Vol. 69, No. 436B, pp. 449–458.) "It is shown that, when the electron free path is large, the theoretical electrical conductivity of single crystal metal films exhibits anomalous anisotropic properties similar to, but even more pronounced than, those found in the anomalous skin effect in anisotropic metals."

537.311.31 : 621.316.842(083.74) **3085**

Nickel-Chromium-Aluminium-Copper Resistance Wire.—A. H. M. Arnold. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 439–447.) Report of an investigation made at the National Physical Laboratory on the suitability of alloys for resistance standards. The alloy 'evanohm', composed of Ni, Cr, Al and Cu, has a resistivity three times that of Mn, and its temperature coefficient can be adjusted to zero by heat treatment. A number of resistance standards made of this wire are undergoing long-term stability tests.

537.311.33 **3086**

Grain-Boundary Structure and Charge-Carrier Transport in Semiconductor Crystals.—H. F. Mataré. (*Z. Naturf.*, Aug. 1955, Vol. 10a, No. 8, pp. 640–652.) "The structural character of boundaries or interfaces between two perfect crystals of different orientation but equal chemical composition defines the behaviour of grain boundaries with respect to carrier transport. The amount of misfit in the grain boundary zone, as well as the amount of energy stored by elastic deformation, defines the electrical properties. The number of free carriers (electrons) in boundary states increases with the cross-potential applied, while positive space charge regions build up on both sides of the boundary. The boundary zone itself has *p*-type character and becomes more conductive when the number of electrons bound to the dangling bonds increases. Grain boundary zones may be as thick as a few tenths of a mm. Extremely small zones are formed by disturbed twins. Two- and three-probe measurements on such bicrystals have been made in order to study the carrier transport phenomena. High current multiplication due to carrier density misfit and gate action in the case of opposite polarization have been found. In addition, contacts were plated to boundary zones and modulation through the bulk material, as in a *n-p-n* junction, was studied. Here current multiplication can reach high values even in a base-to-ground connection. Since those electrons bound to a grain boundary interface by a cross potential may be present only in the form of excitons, in the field of their dangling bonds before adjustment, their time constants for recharging processes might be very short such that it is probable that high-frequency response is improved. Basic elements and consequences of the developed theory and the correlation between boundary stress field and carrier transport are outlined." Similar material is presented in a paper entitled 'Grain Boundaries and Transistor Action' in *Convention Record Inst. Radio Engrs*, 1955, Vol. 3, Part 3, pp. 113–124.

537.311.33 **3087**

***p-n* Junction Theory by the Method of δ Functions.**—H. Reiss. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 530–537.) A concise method is presented for calculating the current flow in one-dimensional semiconductor structures with any number of junctions and contacts. The method indicates the importance of the space derivatives of the hole currents in the neighbourhood of junctions.

537.311.33 **3088**

A Method for Measurement of Surface-Recombination Velocities in Semiconductors using the Photomagnetoelectric Effect in a Sinusoidal Regime.—J. Grosvalet. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 344–347.) The method is based on the phase difference between the photomagnetoelectric and photoresistive voltages discussed previously (1062 of 1955).

537.311.33 : 536.21 **3089**

Thermal Conductivity of Semiconductors.—J. M. Thuillier. (*C. R. Acad. Sci., Paris*, 28th May 1956, Vol. 242, No. 22, pp. 2633–2634.) Addendum to analysis presented previously (799 of March). An error in the calculation is corrected.

537.311.33 : 536.21 **3090**

Thermal Conductivity of Semiconductors.—A. V. Ioffe & A. F. Ioffe. (*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Jan. 1956, Vol. 20, No. 1, pp. 65–75. In Russian.) A discussion of theoretical and experimental work.

537.311.33 : 537.533 **3091**

The Effect of Field Emission on the Behaviour of Semiconductor Contacts.—R. Stratton. (*Proc. Phys. Soc.*, 1st April 1956, Vol. 69, No. 436B, pp. 491–492.) Recent work by Sillars (1084 of April) is extended to include field emission across gaps of arbitrary width and fields varying with the distance from the centre of the contact, such as might arise if a variable work function exists at the gap surfaces.

537.311.33 : [546.28 + 546.289 **3092**

Chemical Interactions among Defects in Germanium and Silicon.—H. Reiss, C. S. Fuller & F. J. Morin. (*Bell Syst. tech. J.*, May 1956, Vol. 35, No. 3, pp. 535–636.) Chemical reaction mechanisms in semiconductor solid solutions are shown to be similar to those in aqueous solutions. A comprehensive report of experimental and theoretical investigations of these mechanisms is presented. The limits of validity of the mass-action principle are examined. 71 references.

537.311.33 : 546.28 **3093**

Theory of Electron Multiplication in Silicon.—J. Yamashita. (*Progr. theor. Phys.*, Feb. 1956, Vol. 15, No. 2, pp. 95–110.) General theory of the conductivity of nonpolar crystals in strong e.s. fields, developed previously [*ibid.*, Oct. 1954, Vol. 12, No. 4, pp. 443–453 (Yamashita & Watanabe)] on a kinetic-statistical basis, is extended to take account of the impact ionization process and is used to explain the electron multiplication in Si *p-n* junctions observed by McKay & McAfee (1079 of 1954).

537.311.33 : 546.28 **3094**

Measurement of Minority Carrier Lifetime in Silicon.—R. L. Watters & G. W. Ludwig. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 489–496.) A method of measurement based on the decay of photocurrent in a specimen exposed to pulsed illumination is used. Limitations on the injection level are discussed. Trapping, barrier and contact effects are taken into account in evaluating the results, which are checked by measurements using a drift technique. Lifetime values $> 1\,500\ \mu s$ for *p*-type crystals and $> 2\,500\ \mu s$ for *n*-type have been found. The temperature dependence of the lifetime was investigated. A value of about 3 500 cm/s at 300°K was determined for the surface recombination velocity of a *p*-type crystal.

537.311.33 : 546.28 **3095**

Diffusion of Donor and Acceptor Elements in Silicon.—C. S. Fuller & J. A. Ditzenberger. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 544–553.) The diffusion of Group-III and Group-V elements in Si has been measured over the temperature range 1 050°–1 350°C. Results are tabulated. In nearly all cases the acceptor elements diffuse more rapidly than the donor elements. Boron and phosphorus exhibit similar diffusional properties; they may form compounds with the Si under the conditions of diffusion.

537.311.33 : 546.28 : 535.37 **3096**

Photon Emission from Avalanche Breakdown in Silicon.—A. G. Chynoweth & K. G. McKay. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 369–376.) Results obtained by Newman (1088 of April) are discussed. Further experiments were made using a junction very close to a surface; the results indicate that light is emitted from breakdown regions distributed over the whole of the junction area, not only where the junction intercepts the surface. The emitted light has a continuous spectrum. Recombination between free electrons and holes is thought to be responsible for the shorter wavelengths, and intra-band transitions for the longer ones. The emission efficiency over the visible spectrum is tentatively estimated as 1 photon per 10^8 electrons crossing the junction.

537.311.33 : 546.289 **3097**

Effect of Water Vapor on Germanium Surface Potential.—A. R. Hutson. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 381–385.) A simple calculation based on the thickness and dielectric properties of the water film adsorbed on the Ge surface gives values of the surface potential in good agreement with the observed values for different degrees of humidity of the ambient atmosphere.

537.311.33 : 546.289 **3098**

Temperature-Dependent Factor in Carrier Lifetime.—R. L. Longini. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 584–585.) Results of measurements on carrier recombination in Ge made by various workers are discussed. It is suggested that rapid recombination believed to occur at dislocations may be due to relaxation of momentum selection rules. When recombination does take place predominantly at dislocations, the lifetime is not necessarily temperature dependent.

537.311.33 : 546.289 **3099**

Time-Dependent Changes of Surface Lifetime in Germanium in the Presence of Electric Fields.—J. D. Nixon & P. C. Banbury. (*Proc. phys. Soc.*, 1st April 1956, Vol. 69, No. 436B, pp. 487–488.) Extension of the work of Henisch & Reynolds (3652 of 1955); curves show the relation between surface-recombination velocity and applied field for both *n*- and *p*-type Ge, and the time variation of the conductance on applying and removing the field.

537.311.33 : 546.289 **3100**

The Absorption of 39-kMc/s (39-Gc/s) Radiation in Germanium.—A. F. Gibson. (*Proc. phys. Soc.*, 1st April 1956, Vol. 69, No. 436B, pp. 488–490.) Experimentally determined values of the absorption coefficient over the temperature range 15°–55°C are in excellent agreement with theory, assuming the effective mass of charge carriers to be of the same order as the electronic mass. The results are not in agreement with those of Klinger (1088 of 1954), which indicate an effective mass about ten times greater.

537.311.33 : 546.289 : 548.24 **3101**

Growth Twins in Germanium.—G. F. Bolling, W. A. Tiller & J. W. Rutter. (*Canad. J. Phys.*, March 1956, Vol. 34, No. 3, pp. 234–240.) The nucleation of twin crystals in Ge requires a certain degree of supercooling; the frequency of occurrence of twins increases with the degree of supercooling. The addition of Ga to the melt lowers the solid/liquid interface energy.

537.311.33 : 546.289 : 669.046.54 **3102**

Single Crystals of Exceptional Perfection and Uniformity by Zone Leveling.—D. C. Bennett & B. Sawyer. (*Bell Syst. tech. J.*, May 1956, Vol. 35, No. 3, pp. 637–660.) Technique for producing semiconductors with very low impurity content and with very uniform impurity distribution is based on traversing a single liquid zone through the crystal. Ge crystals have been produced with transverse variations of resistivity as low as $\pm 3\%$ and longitudinal variations $\pm 7\%$.

537.311.33 : 546.3-1-28-289 **3103**

Preparation of Alloys of Germanium with Silicon and Other Metalloids by Fusion Electrolysis.—M. J. Barbier-Andrieux. (*C. R. Acad. Sci., Paris*, 7th May 1956, Vol. 242, No. 19, pp. 2352–2354.) A whole range of mixed Ge-Si crystals has been obtained by the technique described. Some experiments with Ge-Sn and Ge-As alloys are also mentioned.

537.311.33 : 546.561-31 **3104**

Excitation Spectrum of Excitons in a Solid.—E. F. Gross. (*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Jan. 1956, Vol. 20, No. 1, pp. 89–104. In Russian.) A critical survey of literature with particular reference to Cu_2O. 45 references.

537.311.33 : 546.561-31 **3105**

Occlusions of Cupric Oxide in Cuprous Oxide Layers.—A. I. Andrievski & M. T. Mishchenko. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1893–1897.) Statements made by various authors to the effect that layers of Cu_2O contain crystals of CuO have been confirmed by a microscope investigation. A report is presented including a number of photomicrographs.

537.311.33 : 546.561-31 : 539.23 **3106**

Investigation of the Structure of the Surface of Films of Cuprous Oxide on Different Faces of a Single Crystal of Copper and Determination of the Contact Potential Difference between these Surfaces.—N. B. Gornyi. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 808–816.)

537.311.33 : [546.682.18 + 546.681.19 **3107**

Preparation and Electrical Properties of InP and GaAs.—O. G. Folberth & H. Weiss. (*Z. Naturf.*, Aug. 1955, Vol. 10a, No. 8, pp. 615–619.) Measurements were made of conductivity and Hall effect over the temperature range from −180° to +960°C. Polycrystalline rod specimens were used. Results are shown graphically. Values are deduced for the carrier mobilities and the widths of the energy gaps.

537.311.33 : 546.682.86 **3108**

Preparation of Indium Antimonide. Determination of the Effective Masses.—M. Rodot, P. Duclos, F. Kover & H. Rodot. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2522–2525.) Specimens of various degrees of purity were prepared; impurity concentrations down to 10^{15} centres/cm^3 were attained. Hall-effect and Seebeck-effect measurements indicate that the effective masses of electrons and holes depend greatly on temperature.

537.311.33 : 546.786-31 **3109**

The Preparation of Semiconducting Ceramics based on WO_3, and a Study of Some of their Electrical and Thermal Properties.—G. I. Skanavi & A. M. Kashtanova. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1883–1892.) The preparation of the specimens is described in detail and results are given of numerous experiments. The main properties of the material are as follows: the conductivity varies within relatively wide limits, from 7×10^{-3} to 4 Ω^{-1}.cm^{-1}; the thermo-e.m.f. has negative sign, corresponding to *n*-type conductivity; the temperature coefficient of thermo-e.m.f. is relatively high (0·70–0·85 mV/deg). The material should find application in the production of thermocouples.

537.311.33 : 546.873-31 **3110**

The Electrical Conductivity of Bismuth Oxide.—V. M. Konovalov, V. I. Kulakov & A. K. Fidrya. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1864–1867.) Measurements are reported. In air, at room temperature, the resistivity varied from 10^8 to 10^{10} Ω.cm. When the specimens were heated up to 700°C, the resistivity fell to about 10^2 Ω.cm. The conductivity depends to a great extent on the preparation of the specimens and on their moisture content. The results indicate that within the range of temperatures investigated the conductivity is predominantly of *n*-type, which is contrary to previous conclusions. A considerable positive photoeffect was also observed.

537.32 : 546.562-31 **3111**

A Thermoelectric Effect exhibited by Cupric Oxide in Powder Form.—M. Perrot, G. Peri, J. Robert, J. Tortosa & A. Sauze. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2519–2522.) Experiments have been made with elements comprising powdered CuO compressed between two Cu electrodes. Graphs show the temperature variation of resistance of an element as a whole, and the variation of the thermo-e.m.f. as a function of the temperature difference between the electrodes for several elements; in one case the useful power is 22 mW/cm². Elements using Cu_2O powder give a greater e.m.f. for the same temperature conditions, but their resistance is also greater.

537.533 : 546.815 **3112**

Work Function of Lead.—P. A. Anderson & A. L. Hunt. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 367–368.) The work function of Pb surfaces has been determined by measuring the contact difference of potential with respect to a Ba surface in a special tube. The value obtained is 4·00 ± 0·01 eV. The results indicate that the work function is unaffected when an initially clean Pb surface is exposed to the residual gas in a sealed-off Ba-gettered tube.

538.22 : 621.318.134 **3113**

Micrographic Study of the Order-Disorder Transformation in Lithium Ferrite.—I. Behar. (*C. R. Acad. Sci., Paris*, 14th May 1956, Vol. 242, No. 20, pp. 2465–2468.)

538.22 : 621.318.134 **3114**

Magnetic Properties of Garnet-Type Yttrium Ferrite $5Fe_2O_3 . 3Y_2O_3$.—R. Aléonard, J. C. Barbier & R. Pauthenet. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2531–2533.)

538.221 **3115**

The Behavior of Ferromagnetics under Strong Compression.—F. D. Stacey. (*Canad. J. Phys.*, March 1956, Vol. 34, No. 3, pp. 304–311.) Magnetization curves are given for thin specimens of Ni and Ni-Cu alloys under non-hydrostatic pressures up to 10 000 atm. The saturation magnetizations increase markedly with pressure.

538.221 **3116**

Interpretation of Domain Patterns recently found in BiMn and SiFe Alloys.—J. B. Goodenough. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 356–365.)

538.221 : 538.632 **3117**

Theory of the Hall Effect in Ferromagnetic Alloys.—K. Meyer. (*Z. Naturf.*, Aug. 1955, Vol. 10a, No. 8, pp. 656–657.)

538.221 : 538.652 **3118**

Iron-Aluminium Alloys for Use in Magnetostrictive Transducers.—M. T. Pigott. (*J. acoust. Soc. Amer.*, May 1956, Vol. 28, No. 3, pp. 343–346.) A systematic determination of the electromechanical coupling coefficient k of Fe-Al alloys containing between 12% and 14% Al by weight and annealed at temperatures between 600° and 1 000°C is reported. For annealing temperatures near 1 000°C, k^2 is about 0·05 and is nearly independent of composition; k^2 has a maximum value of 0·12 for an alloy containing 12·3% Al annealed at 650°C. Eddy-current losses are smaller than for soft annealed 'A' nickel.

538.221 : 621.318.134 **3119**

Resonance Widths in Polycrystalline Nickel-Cobalt Ferrites.—M. H. Sirvetz & J. H. Saunders. (*Phys. Rev.*, 15th April 1956, Vol. 102, No. 2, pp. 366–367.) Brief report of measurements at a frequency of 10 kMc/s on ferrites of composition $Co_xNi_{1-x}Fe_2O_4$. The variation of resonance-line width with variation of x up to 0·04 and with variation of temperature between 20° and 350°C is shown graphically and discussed in relation to the crystal properties.

538.221 : 621.318.134 **3120**

Investigation of the Magnetic Spectra of Solid Solutions of some NiZn Ferrites at Radio Frequencies.—L. A. Fomenko. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 18–29. English summary, *ibid.*, Supplement, p. 3.) Results of an experimental investigation of the frequency dependence in the range 0·2–60 Mc/s of the permittivity, permeability and loss angles of oxifer ferrites [*Bull. Acad. Sci. U.R.S.S., sér. phys.*, 1952, Vol. 16, p. 6 (Shol'ts & Piskarev)] with initial permeabilities of 200, 400 and 2 000 G/oersted are presented graphically. Specimens with various dimensions were used; dispersion effects are practically independent of the dimensions.

538.221 : 621.318.134 **3121**

Influence of Alkali and Alkaline-Earth Ions on the Initial Permeability of Manganese-Zinc Ferrites.—C. Guillaud, B. Zega & G. Villers. (*C. R. Acad. Sci., Paris*, 7th May 1956, Vol. 242, No. 19, pp. 2312–2315.) Results of measurements are presented as curves for μ_0/μ as a function of impurity content, where μ_0 is the initial permeability of the pure material and μ that of the impure material. The relation between the effectiveness of the impurity and its ionic radius is studied.

538.221 : 621.318.134 **3122**

Initial Permeability and Grain Size of Manganese-Zinc Ferrites.—C. Guillaud & M. Paulus. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2525–2528.) A graph shows the relation between initial permeability and mean grain size, derived on the basis of a careful analysis of the distribution of grain size in 100 specimens. The results are consistent with a mechanism involving rotation of the direction of spontaneous magnetization for grains whose mean dimension is $< 5{\cdot}5\ \mu$, and domain-wall displacements for larger grains.

538.23 **3123**

A Relation between Hysteresis Coefficient and Permeability: Part 3—Ferrite Cores with Rectangular Loop. Part 4—Influence of Coercive Force.—M. Kornetzki. (*Z. angew. Phys.*, March 1956, Vol. 8, No. 3, pp. 127–135.) Continuation of the investigation noted earlier (1714 of 1955). Anomalies

due to the large magnetic crystal energy of several materials are noted and experimental results obtained by various workers are discussed.

539.23 : 537/538 **3124**

International Colloquium on the Present State of Knowledge of the Electric and Magnetic Properties of Thin Metal Films in Relation to their Structure.—(*J. Phys. Radium*, March 1956, Vol. 17, No. 3, pp. 169–306.) French text and English abstracts are presented of 27 papers given at a colloquium held at Algiers in April 1955.

539.23 : 546.561-31 **3125**

Electron Interference at Electrolytically Polished Surfaces after Cathode Sputtering.—A. Ladage. (*Z. Phys.*, 7th Feb. 1956, Vol. 144, No. 4, pp. 354–372.) Apparatus is described by means of which thin Cu_2O films were detected on the surface of cleaned Cu exposed to air for 30 minutes.

549.514.5 : 534.21-16 **3126**

Propagation of Longitudinal Waves and Shear Waves in Cylindrical Rods at High Frequencies.—McSkimin. (See 2933.)

621.3.049.75 **3127**

Silver Migration in Electric Circuits.—O. A. Short. (*Tele-Tech & Electronic Ind.*, Feb. 1956, Vol. 15, No. 2, pp. 64–65..113.) Electrolytic migration of silver used in components and printed circuits may be reduced by covering the silver completely with solder, or by Cr plating. An organic coating is effective if soluble salts are first removed from the surface covered.

621.315.61 : 621.317.335.029.64 **3128**

Temperature Dependence of Loss Angle and Dielectric Constant of Solid Insulating Materials in the 4-kMc/s Range.—Gross. (See 3139.)

621.315.612.6 **3129**

Electrical Resistivity of Vitreous Ternary Lithium-Sodium Silicates.—S. W. Strauss. (*J. Res. nat. Bur. Stand.*, April 1956, Vol. 56, No. 4, pp. 183–185.) Glasses with compositions in the system $xLi_2O : (1-x)Na_2O : 2SiO_2$ have been investigated over the temperature range 150°–230°C. Resistivity/composition characteristics are presented.

621.315.615.9 : 621.319.4 **3130**

Polychloronaphthalene-Impregnated-Paper Capacitors.—Coquillion. (See 2980.)

MATHEMATICS

517.9 **3131**

The Asymptotic Solution of Linear Differential Equations of the Second Order in a Domain containing One Transition Point.—F. W. J. Olver. (*Phil. Trans. A*, 19th April 1956, Vol. 249, No. 959, pp. 65–97.)

517.941.91 **3132**

The Interrelation between the Phase Planes of Rayleigh's Equation and van der Pol's Equation.—V. V. Kazakevich. (*C. R. Acad. Sci. U.R.S.S.*, 1st April 1956, Vol. 107, No. 4, pp. 521–523. In Russian.) The equations considered are: $\dot{y} - \mu f(\dot{y}) + y = 0$ and $\ddot{y} - \mu F(y)\dot{y} + y = 0$.

517 **3133**

Spheroidal Wave Functions. [Book Review]—J. A. Stratton et al. Publishers: Technology Press of Massachusetts Institute of Technology, and John Wiley & Sons, New York, 1956, 611 pp., $12.50. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 951–952.) Contains numerical tables and an introduction, together with a reprint of a paper on elliptic and spheroidal wave functions [1594 of 1942 (Chu & Stratton)].

MEASUREMENTS AND TEST GEAR

621.3.011.3(083.74) : 621.318.42 **3134**

The Calibration of Inductance Standards at Radio Frequencies.—L. Hartshorn & J. J. Denton. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 429–438. Discussion, p. 438.) The practice adopted at the National Physical Laboratory for calibrating laboratory standards is described. An accuracy within about 1 part in 10^4 is obtained over a considerable range of inductance values. The accuracy associated with such standards is determined partly by the definition of inductance used; this aspect as well as the experimental technique is discussed.

621.317.3 : 551.594.6 **3135**

Measurement of the Amplitude Probability Distribution of Atmospheric Noise.—H. Yuhara, T. Ishida & M. Higashimura. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 101–108.) Noise picked up on a 2-m vertical aerial is amplified at an i.f. of 100 kc/s, the output is sliced and the resulting groups of 100-kc/s pulses are counted. Results obtained during the summer of 1955, on a frequency of 3·5 Mc/s, using a bandwidth of 2·4 kc/s, show that the noise includes random and impulsive components.

621.317.3 : 621.319.4 : 681.142 **3136**

Industrial Measurement of the Temperature Coefficient of Ceramic-Dielectric Capacitors.—J. Peyssou & J. Ladefroux. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 355–371.) Known beat-frequency and self-synchronizing techniques are reviewed. The accuracy and speed of measurements is increased by using an automatic machine incorporating an analogue computer. The construction of a temperature-coefficient distribution curve for a batch of 4 000 capacitors is described. For a shorter version, in English, see *Tele-Tech & Electronic Ind.*, April 1956, Vol. 15, No. 4, pp. 70–71..166.

621.317.3 : 621.396.822 **3137**

New Method of measuring the Effective Value of Band-Limited Radio Noise Voltage.—K. Kawakami & H. Akima. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 109–113.) The noise voltage is passed through a pentode frequency-doubling stage and the output is linearly rectified and smoothed. The resulting voltage is the mean square of the input voltage. Equipment is described for measurements on a centre frequency of 455 kc/s, giving accurate results for an input dynamic range of 30 dB.

621.317.33 : 546.28 **3138**

The Measurement of the Electrical Resistivity of Silicon.—R. H. Creamer. (*Brit. J. appl. Phys.*, April 1956, Vol. 7, No. 4, pp. 149–150.) The method described by Valdes (1502 of 1954) was modified by using probes made from wires containing a donor or acceptor impurity for measurements on *n*- or *p*-type Si respectively. Potentials were measured with a standard potentiometer, giving an accuracy within ± 7% for resistivities up to several hundred Ω.cm.

621.317.335.029.64 : 621.315.61 **3139**

Temperature Dependence of Loss Angle and Dielectric Constant of Solid Insulating Materials in the 4-kMc/s Range.—F. Gross. (*Nachrichtentech. Z.*, March 1956, Vol. 9, No. 3, pp. 124–128.) Measurements were made on rod specimens of ceramics, glass and plastics used in the manufacture of valves and other equipment, over the temperature range 20°–350°C, using an E_{010}-mode resonator. Theory based on that of Horner et al. (966 of 1946) is outlined; results are presented in tables and graphs.

621.317.335.3.029.64 : 621.315.614.6 **3140**

Birefringence and Rectilinear Dichroism of Paper at 9 350 Mc/s.—R. Servant & J. Gougeon. (*C. R. Acad. Sci., Paris*, 7th May 1956, Vol. 242, No. 19, pp. 2318–2320.) The complex dielectric constant of a pile of sheets of paper has been determined by a waveguide method using a s.w.r. meter within which the material under test is located. Measurement results are evaluated as absorption coefficients and refractive indices; very considerable differences are observed for the cases of the electric vector (*a*) parallel to and (*b*) perpendicular to the plane of the paper sheets. Some results obtained with kraft paper are shown graphically.

621.317.337 : 621.372.413 **3141**

Measurement of the *Q*-Factor of Cavity Resonators, using a Straight Test Line.—H. Urbarz. (*Nachrichtentech. Z.*, March 1956, Vol. 9, No. 3, pp. 112–118.) Methods appropriate for measurements on resonators with only one coupling point, such as those associated with klystrons, are based on determination of the s.w.r. and the shift of the minimum along a test line terminated by the resonator. The effect of loading on the *Q*-factor is discussed. Measurements are reported indicating the variation of the resonator input admittance with the area of the coupling loop.

621.317.34 : 621.3.018.7 **3142**

An Approximate Method for investigating Distortion of Test Pulses transmitted over Coaxial Cables.—H. Larsen & H. E. Martin. (*Frequenz*, March 1956, Vol. 10, No. 3, pp. 65–76.) In practice, the waveforms of pulses used for testing may deviate considerably from ideal forms such as rectangular or $\cos^2$. The Fourier components of the actual initial waveform can be determined with sufficient accuracy by analysing its oscillogram. The waveform of the transmitted pulse can then be determined as usual by multiplying together the pulse spectral function and the system transfer function and transforming the product. Application of the theory is described in relation to tests on wide-band cables several km long.

621.317.4 **3143**

A Rapid Method for measuring Coercive Force and other Ferromagnetic Properties of Very Small Samples.—G. W. van Oosterhout. (*Appl. sci. Res.*, 1956, Vol. B6, Nos. 1/2, pp. 101–104.) The method is based on measurement of the alternating e.m.f. generated when the sample is caused to vibrate within a search coil.

621.317.443 **3144**

Description of a Balance for the Measurement of Magnetization from 1·4°K to Room Temperature.—R. Conte. (*C. R. Acad. Sci., Paris*, 23rd May 1956, Vol. 242, No. 21, pp. 2528–2531.)

621.317.6 : 621.385.5 : 621.376.22 **3145**

Study of Amplitude Modulation applied via a Pentode Suppressor Grid.—Loeckx. (See 3237.)

621.317.7 : 537.54 : 621.396.822.029.6 **3146**

On the Effective Noise Temperature of Gas-Discharge Noise Generators.—W. D. White & J. G. Greene. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, p. 939.) A method of calculating the noise temperature is indicated.

621.317.7 : 537.54 : 621.396.822.029.6 **3147**

Wide-Band Noise Sources using Cylindrical Gas-Discharge Tubes in Two-Conductor Lines.—R. I. Skinner. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 491–496.) Noise sources for the dm-λ band are discussed. A noise output which is level over several octaves can be obtained by matching a cylindrical gas-discharge tube directly to a two-conductor line. The matching can be achieved by using conductors of various shapes. Practical design procedure is outlined.

621.317.72 + 621.317.772 **3148**

An A.C. Potentiometer for Measurement of Amplitude and Phase.—M. J. Somerville. (*Electronic Engng*, July 1956, Vol. 28, No. 341, pp. 308–309.) A simple circuit using a.c. coupled amplifiers permits generation of quadrature components whose phase relation remains unchanged when substantial phase shifts occur in the couplings.

621.317.73 + 534.64 **3149**

An Impedance Measuring Set for Electrical, Acoustical and Mechanical Impedances.—E. W. Ayers, E. Aspinall & J. Y. Morton. (*Acustica*, 1956, Vol. 6, No. 1, pp. 11–16.) "An impedance to be measured is compared with a reference impedance of similar nature by connecting each in turn to a source of adjustable strength. If the internal impedance of the source is constant, the vector ratio of the unknown and reference is the ratio of the changes in stimulus required to restore the source to short-circuit conditions, or the reciprocal of this ratio if the source is restored to open-circuit conditions."

621.317.733.029.4 : 621.375.2 **3150**

A Tuned Differential Amplifier for Low-Frequency Bridges.—W. K. Clothier & F. C. Hawes. (*Aust. J. appl. Sci.*, March 1956, Vol. 7, No. 1, pp. 38–44.) The amplifier described is suitable for use as a balance detector where there is high impedance between both detector points and ground. Rejection factors greater than 30 000 are obtained for in-phase input voltages up to 10 V. The amplifier is tunable over the frequency range 15–20 000 c/s by means of ladder-type feedback networks. The discrimination against third harmonics of the selected frequency is 130. Maximum gain is 150 000.

621.317.734 **3151**

Extending the Limits of Resistance Measurement using Electronic Techniques.—G. Hitchcox. (*J. Brit. Instn Radio Engrs*, June 1956, Vol. 16, No. 6, pp. 299–309.) Methods for measuring resistance are surveyed with special attention to those for very low and very high resistance. In one method for dealing with very low resistance, test currents with triangular waveform are used to reduce thermal dissipation. A commercial general-purpose megohmmeter is described in some detail.

621.317.734 **3152**

A Logarithmic Megohmmeter.—P. Hariharan & M. S. Bhalla. (*J. sci. Instrum.*, April 1956, Vol. 33, No. 4, pp. 158–159.) An ohmmeter based on the logarithmic grid-current/anode-current characteristic of a triode valve covers the range from 1 to 10^6 MΩ on a single approximately logarithmic scale.

621.317.75 : 621.396.3 **3153**

The Response of Radio Spectrometers.—J. Marique. (*Rev. HF, Brussels*, 1956, Vol. 3, No. 5, pp. 167–177.) The spectrum of repeated signals such as the pulses in on-off telegraphy systems is a function of two factors, one depending on the waveform of the individual signals and the other on the repetition process. The operation of a spectrometer comprising a cascaded-tuned-circuit filter (813 of 1955) is discussed, taking as criterion the time interval $T = 2/B_F$, where B_F is the filter bandwidth. See also 1900 of 1955.

621.317.755 : 531.76 **3154**

Four-Place Timer codes Oscillograph Recordings.—S. E. Dorsey. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 154–156.) A 1-kc/s signal from a tuning-fork oscillator is fed through a trigger circuit into a chain of four decade counters which have additional 'staircase' outputs. Differentiation and combination of these outputs provides a c.r.o. trace indicating time in increments of 0·001 sec up to 9·999 sec, with markers for tenths, hundredths and thousandths of a second. A simple calibration method is described.

621.317.79 : 538.632 : 537.311.33 **3155**

A Simple Apparatus for recording the Variation of Hall Coefficient with Temperature.—E. H. Putley. (*J. sci. Instrum.*, April 1956, Vol. 33, No. 4, p. 164.)

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

536.52 : 621.385.029.6.032.21 **3156**

A New Method for the Measurement of Rapid Fluctuations of Temperature.—Dehn. (See 3258.)

550.837 **3157**

Geophysical Prospection of Underground Water in the Desert by means of Electromagnetic Interference Fringes.—G. L. Brown : M. A. H. El-Said. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, p. 940.) Comment on 1171 of April and author's reply.

620.179.1 : 621-52 **3158**

An Electronic Position-Tracking Instrument.—(*Tech. News Bull. nat. Bur. Stand.*, May 1956, Vol. 40, No. 5, pp. 68–69.) The motion of a metal object in a nonconducting medium is automatically followed by a mutual-inductance probe associated with a servo-mechanism.

621.317.39 : 531.71 **3159**

Mechanic-Electric Transducer.—K. S. Lion. (*Rev. sci. Instrum.*, April 1956, Vol. 27, No. 4, pp. 222–225.) A system for converting mechanical displacement into a voltage is based on the local variations of the voltage between a pair of electrodes in a luminous low-pressure discharge excited by a r.f. field.

621.317.39 : 621.383 **3160**

A Wide-Range Photoelectric Automatic Gain Control.—C. Riddle. (*Electronic Engng*, July 1956, Vol. 28, No. 341, pp. 288–292.) "A photocell and valve are arranged in such a way that the output voltage is proportional to the light modulation, and independent of the value of the steady light flux. The circuit is extremely simple, and the range over which the light flux may vary is very large (100 000 : 1)."

621.383 : 77 : 522.61 **3161**

Obtaining the Spectra of Faint Stars by Electronic Photography.—A. Lallemand & M. Duchesne. (*C. R. Acad. Sci., Paris*, 28th May 1956, Vol. 242, No. 22, pp. 2624–2626.)

621.383.5 : 531.745 : 621.396.934 **3162**

Photoelectric Angular-Error Sensors.—R. A. Nidey & D. S. Stacey. (*Rev. sci. Instrum.*, April 1956, Vol. 27, No. 4, pp. 216–218.) A device is described in which Ge-junction photocells are used to produce a voltage dependent on the orientation of a research rocket relative to the sun. See also 3182 below.

621.384.611 **3163**

Improving the Characteristics of the Cyclotron Beam.—W. B. Powell. (*Nature, Lond.*, 2nd June 1956, Vol. 177, No. 4518, p. 1045.) Brief preliminary note of a technique involving the use of beam-defining slits on the dee interface.

621.384.612 **3164**

Excitation of Synchrotron Oscillations due to Electron Radiation Fluctuations in a Strong-Focusing Accelerator.—A. A. Kolomenski. (*Zh. eksp. teor. Fiz.*, Jan. 1956, Vol. 30, No. 1, pp. 207–209.) Theoretical note. If $H_{max} \simeq 10^4$ oersted and $E \simeq 10$ kMeV, then the radial r.m.s. deviation of the orbit is of the order of a fraction of a centimetre.

621.384.612 **3165**

Influence of Radiation on Betatron Oscillations of Electrons in Synchrotrons with Strong [alternating-gradient] **Focusing.**—A. N. Matveev. (*C. R. Acad. Sci. U.R.S.S.*, 11th April 1956, Vol. 107, No. 5, pp. 671–674. In Russian.)

621.384.612 : 681.142 **3166**

Analog Computer for the Differential Equation $y'' + f(x)y + g(x) = 0$.—Bodenstedt. (See 2973.)

621.385.833 **3167**

Electrostatic Fields permitting Rigorous Calculation of the Electron Paths.—H. Grümm. (*Ann. Phys., Lpz.*, 29th Feb. 1956, Vol. 17, Nos. 4/5, pp. 269–280.) Analysis is given separately for two-dimensional fields (pp. 269–274) and for rotationally symmetrical fields (pp. 275–280).

621.385.833 **3168**

Calculation of Electrostatic [electron] **Lenses.**—U. Timm. (*Z. Naturf.*, Aug. 1955, Vol. 10a, No. 8, pp. 593–602.) The use of matrix methods is described and illustrated.

621.385.833 **3169**

Construction of Magnetic Electron Lenses.—P. Durandeau. (*J. Phys. Radium*, March 1956, Vol. 17, Supplement to No. 3, *Phys. appl.*, pp. 18A–25A.) Design of short-focus lenses for very-high-velocity electrons is based on measurements of the field along the axis by the method described previously (1743 of 1953).

621.385.833 **3170**

Stereoscopic Reflection Electron Microscopy.—D. E. Bradley, J. S. Halliday & W. Hirst. (*Proc. phys. Soc.*, 1st April 1956, Vol. 69, No. 436B, pp. 484–485, plate.) The technique is briefly described, with some practical examples.

621.385.833 **3171**

Aperture Aberration of 5th Order in Spherically Corrected Electron Microscopes.—W. E. Meyer. (*Optik, Stuttgart*, 1956, Vol. 13, No. 2, pp. 86–91.)

621.385.833 **3172**

The Lower Limit of Aperture Aberration in Magnetic Electron Lenses.—H. Grümm. (*Optik, Stuttgart*, 1956, Vol. 13, No. 2, pp. 92–93.)

621.385.833 : 621.383.2 **3173**

Area Sources of Low-Energy Electrons for Electron-Optic Studies.—R. J. Schneeberger. (*Rev. sci. Instrum.*, April 1956, Vol. 27, No. 4, pp. 211–215.) If the final stages of the design of electron-optical systems for image tubes are carried out with a demountable tube containing a photocathode, the latter requires repeated cleaning and re-processing. Three sources suitable as substitutes for the photocathode are discussed, viz., (*a*) a thermionic source which sprays electrons through a perforated large-area electrode at about cathode potential, (*b*) a secondary-emission arrangement using a perforated plate with baffles associated with individual holes, and (*c*) a secondary-emission transmission arrangement.

621.386 : 621.383.2 **3174**

Cineroentgenography with Image Intensification.—F. J. Euler & P. A. Virbal. (*Elect. Engng, N.Y.*, March 1956, Vol. 75, No. 3, pp. 238–242.) Intensification of the X-ray image by means of a special form of image-intensifier tube permits shortening of exposure time and increase in thickness of material examined in studies of objects in motion.

621.387.4 : 621.314.7 **3175**

The Application of Transistors to the Trigger, Ratemeter and Power-Supply Circuits of Radiation Monitors.—E. Franklin & J. B. James. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 497–504. Discussion, pp. 516–518.) General requirements and conditions of use of radiation monitors for γ- and β-ray survey in connection with geological prospecting are outlined. Discussion indicates that junction transistors are preferable to either filament or cold-cathode valves or point-contact transistors for these applications.

621.389 **3176**

An Electronic Machine for Statistical Particle Analysis.—H. N. Coates. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 479–484.) "A system is described for associating and collecting the intercepts of individual particles in a particle scanning system, where the information is presented as a function of the scanning voltages. A series of stores is used to segregate the intercepts, each store having its own memory system and provision for re-use on completion of the scanning of the particle with which it is associated; the stores can thus be used many times during a single frame scan. A method of adding the intercepts of each particle to obtain a measure of the area of the particle is described, but this must be regarded as only one of the possibilities of extracting information from the series of intercepts collected."

621.396.934 **3177**

Missile Guidance by Three-Dimensional Proportional Navigation.—F. P. Adler. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 500–507.)

621.398 : 621.376 **3178**

Telemetering Demodulator for Wide-Band F.M. Data.—T. D. Warzecha. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 157–159.) Demodulation of 12 subcarrier signals is effected by a pulse-averaging technique after recording the signals at a reduced tape speed and converting f.m. to p.f.m.

621.398 : 621.396.93 **3179**

Remote Radio Control of a Train.—(*Elect. J.*, 30th March 1956, Vol. 156, No. 4059, pp. 998–999.) Brief account of a system which has been successfully operated in the U.S.A.

621.398 : 621.396.934 **3180**

Shipboard Telemetering for Terrier Missiles.—W. S. Bell & C. W. Schultz. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 134–137.) Description of equipment for a six-channel f.m./f.m. system providing magnetic-tape recordings of missile data.

621.398 : 621.396.934 **3181**

Transistor Modulator for Airborne Recording.—J. L. Upham, Jr, & A. I. Dranetz. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 166–169.) Description of a p.p.m. telemetry system for indicating pressure or acceleration, based on the displacement of the core of a differential transformer.

621.398 : 621.396.934 **3182**

Transistors telemeter Small Missiles.—C. M. Kortman. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 145–147.) Rate of spin of a missile 2 in. in diameter is determined from the cyclic frequency shift produced by the rotation of a Ge photocell exposed to the ambient light and connected across the coil of a junction-transistor Hartley oscillator. Curves showing oscillator frequency plotted against light intensity, temperature, etc. are given.

621.396.934 **3183**

Guidance. [Book Review]—A. S. Locke & collaborators. Publishers: Van Nostrand, Princeton, N.J., and Macmillan, London, 1955, 729 pp., $12.50 or 90s. (*Nature, Lond.*, 2nd June 1956, Vol. 177, No. 4518, pp. 1003–1004.) A general introduction and reference book, constituting the first of a projected series of five books on the principles of guided-missile design. The subjects involved include servomechanism theory, aerodynamics, radar, navigation, communications and the application of computers.

PROPAGATION OF WAVES

538.566.029.43 : 551.594.6 **3184**

Influence of the Horizontal Geomagnetic Field on Electric Waves between the Earth and the Ionosphere travelling Obliquely to the Meridian.—Schumann. (See 3060.)

621.396 **3185**

Symposium on Communications by Scatter Techniques.—(*Trans. Inst. Radio Engrs*, March 1956, Vol. CS-4, No. 1, pp. 1–122.) The text is given of papers presented at a symposium held in Washington in November 1955. These include the following:

Some Practical Aspects of Auroral Propagation.—H. G. Booker (p. 5).

Progress of Tropospheric Propagation Research related to Communications beyond the Horizon.—J. H. Chisholm (pp. 6–16).

Practical Considerations for Forward Scatter Applications.—J. R. McNitt (pp. 28–31).

Some Meteorological Effects on Scattered V.H.F. Radio Waves.—B. R. Bean (pp. 32–38).

Point-to-Point Radio Relaying via the Scatter Mode of Tropospheric Propagation.—K. A. Norton (pp. 39–49).

A Simplified Diversity Communication System for Beyond-the-Horizon Links.—F. J. Altman & W. Sichak (pp. 50–55).

V.H.F. Trans-horizon Communication System Design.—R. M. Ringoen (pp. 77–86).

System Parameters using Tropospheric Scatter Propagation.—H. H. Beverage, E. A. Laport & L. C. Simpson (pp. 87–96).

A Simple Picture of Tropospheric Radio Scattering.—W. E. Gordon (pp. 97–101).

Some Ionosphere Scatter Techniques.—D. A. Hedlund, L. C. Edwards & W. A. Whitcraft, Jr (pp. 112–117).

Signal Fluctuations in Long-Range Overwater Propagation.—W. S. Ament & M. Katzin (pp. 118–122).

Abstracts of some of these are given in *Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part I, p. 831.

621.396.11 **3186**

Field Strength in the Vicinity of the Line of Sight in Diffraction by a Spherical Surface.—K. Furutsu. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 55–76.) The convergency of the formula for diffraction by a spherical earth is improved by using the expression for a flat earth, with an appropriate correction in the form of an integral.

621.396.11 : 551.510.535 **3187**

Observations of Ionospheric Absorption at the K.N.M.I. [Royal Netherlands Meteorological Institute].—van Daatselaar. (See 3054.)

621.396.11 : 551.510.535 **3188**

On the Existence of a 'Q.L.'-'Q.T.' 'Transition-Level' in the Ionosphere and its Experimental Evidence and Effect.—D. Lepechinsky. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 297–304.) See 1767 of 1955 (Lepechinsky & Durand).

621.396.11 : 551.594.6 **3189**

The Propagation of a Radio Atmospheric.—C. M. Srivastava. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 542–546.) Analysis is presented assuming that the original disturbance is a rectangular pulse of duration 100 μs and that propagation takes place by multiple reflections in the waveguide constituted by the earth and the ionosphere. The theory provides an explanation of the smooth oscillating waveform of atmospherics received from a distance.

621.396.11 : 621.396.674.3 **3190**

Radiation from a Vertical Antenna over a Curved Stratified Ground.—J. R. Wait. (*J. Res. nat. Bur. Stand.*, April 1956, Vol. 56, No. 4, pp. 237–244). Analysis is presented on the basis of a specified surface impedance at the earth's surface.

621.396.11.001.57 **3191**

Multipath Simulator tests Communications.—A. F. Deuth, H. C. Ressler, J. W. Smith & G. M. Stamps. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 171–173.) A system designed for laboratory testing of long-range communication equipment is described. Two signal paths are provided by acoustic transducers operating at 150 kc/s in air which is disturbed by heat or fans to effect frequency-selective random fading.

621.396.11.029.4 : 551.594.6 **3192**

Propagation of Audio-Frequency Radio Waves to Great Distances.—F. W. Chapman & R. C. V. Macario. (*Nature, Lond.*, 19th May 1956, Vol. 177, No. 4516, pp. 930–933.) Observations of atmospherics waveforms have been supplemented by simultaneously recording the relative amplitudes of the frequency components in the waveform spectrum. Magnetic recording techniques were used to obtain permanent records of all disturbances reaching a vertical rod aerial. A second channel on the magnetic tape provided information as to the source of individual disturbances. The spectrometer was a modified form of that used previously [419 of 1954 (Chapman & Matthews)]. The results described were obtained from observations of cloud-to-ground discharges at known distances up to about 4 000 km. In all cases marked absorption was found at frequencies around 1–2 kc/s. An attenuation/frequency curve is presented linking the results with those obtained by Eckersley (*J. Instn elect. Engrs*, Sept. 1932, Vol. 71, No. 429, pp. 405–454) on long-distance radio transmissions at frequencies up to about 30 Mc/s. For a range of frequencies below 200 or 300 c/s the attenuation is no greater than for short waves.

621.396.11.029.45 **3193**

Long-Distance Propagation of 16-kc/s Waves.—N. M. Rust. (*Marconi Rev.*, 1st Quarter 1956, Vol. 19, No. 120, pp. 47–52.) Discussion of papers by Budden (2773 of 1953) and Pierce (2404 of 1955) suggests that the experimental results can be explained qualitatively in terms of simple ionosphere/ground-reflection propagation, taking into account up to four hops, without invoking more elaborate theories. The need for further experimental work is emphasized.

621.396.11.029.51 **3194**

Change of Phase with Distance of a Low-Frequency Ground Wave propagated across a Coast-Line.—B. G. Pressey, G. E. Ashwell & C. S. Fowler. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 527–534.) Continuation of work described previously (1782 of 1953). Observations were made on a frequency of 127·5 kc/s along a number of paths of lengths up to 22 km radiating from a transmitter near Lewes, England, and crossing the coast between Pevensey and Littlehampton; some paths tangential to the coast-line and some at right angles to the radials were also studied. The results confirm the existence of the phase-recovery effect on passing from low-conductivity ground to sea water. They also indicate systematic phase variations whose magnitudes decay from about 4° near the coast to a negligible amount at 6 λ out to sea. A very marked phase disturbance within $\lambda/2$ of the coast on the landward side is also evident; this is similar to that previously observed over geological boundaries on land.

621.396.11.029.51 **3195**

The Deviation of Low-Frequency Ground Waves at a Coast-Line.—B. G. Pressey & G. E. Ashwell. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 535–541.) "After consideration of the methods which have been suggested for computing the deviation of ground waves at a coast-line, the phenomenon is re-examined in the light of recent experimental and theoretical work on the phase disturbances at such a boundary. It is shown that the deviation may be calculated from the rate of change of phase with distance along the path of propagation. The changes in this rate which occur at the boundary give rise to a considerable increase in the magnitude of the deviation as the receiving point is brought within a few wavelengths of that boundary. This increase near the coast seems to provide an explanation of the unexpectedly large deviations previously observed at medium frequencies. A series of simultaneous measurements of the phase change and the deviation at 127·5 kc/s along a number of paths crossing the south coast of England are described. Although general agreement between the measured deviations and those derived from the phase curves was obtained on some paths, there were appreciable discrepancies on others. These discrepancies are attributed to the irregularities in the phase surface which were evident over the area and which the method of derivation did not take into account."

621.396.11.029.55 : 551.510.535 **3196**

The Prediction of Maximum Usable Frequencies for Radiocommunication over a Transequatorial Path.—G. McK. Allcock. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 547–552.) "Times of reception of 15 Mc/s radio waves over a transequatorial path of 7 500 km have been recorded throughout the recent period of declining solar activity (1950–54). The analysis of these times has shown that predictions of m.u.f. made by the usual control-point method were, in general, too high by about 4 Mc/s, and at times by as much as 7 Mc/s or more. This is contrary to the normal experience for long transmission paths lying within a single hemisphere. When a transmission mechanism involving multiple geometrical reflections is assumed instead of the forward-scattering mechanism implied by the control-point method, it is found that the path can be considered, for the purpose of predicting m.u.f.s, to consist of three reflections. The discrepancies between prediction and observation, which still remain after a 3-reflection mechanism has been invoked, are attributed mainly to reflections from the sporadic-E region at the southernmost reflection point, although it is possible that lateral deviation of the radio waves is also a contributing factor."

621.396.11.029.55 : 551.510.535 **3197**

Back-Scatter Ionospheric Sounder.—E. D. R. Shearman & L. T. J. Martin. (*Wireless Engr*, Aug. 1956, Vol. 33, No. 8, pp. 190–201.) Equipment is described for studying waves reflected from irregularities on the earth's surface and propagated back to the source via the ionosphere. The design of a suitable 150-kW pulse transmitter which can be simply tuned to any frequency in the band 10–27 Mc/s is discussed. The same 3-wire rhombic aerials are used for transmission and reception, with a tunable transmit-receive switch. A receiver of the type described by Piggott (2301 of 1955) provides an output suitable for presentation of the received echoes on a normal timebase display. A photographic record is made of this display, and continuous range/time ($p't$) records are also obtained. The same transmitter and receiver are also used with a continuously rotating Yagi aerial and p.p.i. By using speeded-up kinematography, the changes occurring over 24 h may be shown in a few minutes. See also 1854 and 1855 of June (Shearman).

621.396.11.029.6 : 551.510.52 **3198**

Some Considerations for the Field Strength of Ultra-short Waves at Night.—K. Tao. (*J. Radio Res. Labs, Japan*, Jan. 1956, Vol. 3, No. 11, pp. 77–99.) The high level of field strength found locally at night is caused by reflection at a tropospheric inversion layer. The formation of such layers is discussed and related to the prevailing meteorological conditions.

621.396.11.029.62 : 551.510.52 **3199**

Investigations of the Propagation of Ultra-short Waves.—R. Schünemann. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1956, Vol. 64, No. 4, pp. 107–123.) Expressions are derived relating received field strength to atmospheric pressure, temperature and humidity and their height gradients, while taking account of diffraction at the earth's surface. Verifying experiments were made over a 76-km path, using a frequency of 68 Mc/s, with the transmitter aerial at a height of 90 m and the receiver aerial at a height of 30 m. The measured field strengths were correlated with meteorological observations; results are shown graphically for eight months, first for the main refracted and diffracted wave only, and then taking account of the reflected wave, which makes an effective contribution for 15%–30% of the time.

621.396.812.3 : 551.510.535 **3200**

A Correlation Treatment of Fading Signals.—N. F. Barber. (*J. atmos. terr. Phys.*, June 1956, Vol. 8, No. 6, pp. 318–330.) An examination in terms of the complete correlogram is made of the fading signals observed at three receivers located at the apices of a right-angled isosceles triangle with equal arms of length 91 m. Methods based on three different sets of assumptions are used to interpret the correlograms in relation to ionospheric drifts. Discussion indicates that a quadratic method of analysis is not affected by decay in the correlogram.

621.396.11.029.62 **3201**

Atlas of Ground-Wave Propagation Curves for Frequencies between 30 Mc/s and 300 Mc/s. [Book Review]—B. van der Pol. Publishers: International Telecommunication Union, Geneva, 1955, 35 pp. + 174 diagrams, $8.55. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, p. 952.) Information prepared at the request of the C.C.I.R. is presented regarding propagation over a spherical earth allowing for standard atmospheric refraction. The curves are preceded by an outline of the theory.

RECEPTION

621.376.23 : 621.396.822 **3202**

Interaction of Signal and Noise in an Inertial Detector.—L. S. Gutkin. (*Radiotekhnika, Moscow*, Feb. & March 1956, Vol. 11, Nos. 2 & 3, pp. 43–53 & 51–62.) The detection by a linear inertial detector of a signal in the presence of noise is analysed for the case when the signal is (*a*) unmodulated, and (*b*) amplitude modulated. The results are compared with the corresponding relations for a non-inertial detector. The detector arrangement considered is a diode with *RC* circuit.

621.376.33 : 621.396.82 **3203**

Fourier Representation of a Demodulated Beat Oscillation.—R. Leisterer. (*Elektronische Rundschau*, Jan. 1956, Vol. 10, No. 1, pp. 19–20.) The analysis presented shows that, if two sinusoidal signals, slightly differing in frequency, are applied via an ideal amplitude limiter to a linear wide-band f.m. discriminator, then the l.f. output voltage due to interference will increase with the signal frequency separation, and the waveform will depend on the amplitude ratio of the signals.

3204

621.396.62 + 621.395.625.3 + 621.395.92] : 621.314.7

Transistor Circuitry in Japan.—(*Electronics*, July 1956, Vol. 29, No. 7, pp. 120–124.) Circuits and characteristics of four types of broadcast receiver, a battery-operated tape recorder and a hearing aid are given.

621.396.621 + 621.397.62 **3205**

Preventing Fires from Electrical Causes in the Design and Manufacture of Radio and Television Receivers.—H. T. Heaton. (*Trans. Inst. Radio Engrs*, April 1955, Vol. BTR-1, No. 2, pp. 28–36.)

621.396.621 : 621.396.828 **3206**

The Compensation of Interference in Carrier-Frequency Receivers by means of an Opposing Receiver connected in Parallel.—H. Kaden. (*Frequenz*, March 1956, Vol. 10, No. 3, pp. 76–82.) Rigorous analysis is presented for the nonideal case, i.e. for circuits with arbitrary response characteristics over the pass band, assuming a sinusoidal signal of frequency within the pass band of the main receiver but outside

that of the compensating receiver, and short interfering pulses. Rectifiers with square-law and broken-line characteristics are considered as demodulators; the broken-line characteristic leads to more effective elimination of the interference. For pulses occurring over a certain signal-phase range, the effect of the parallel receiver may be to increase the interference.

621.396.621.029.62 : 621.396.662 : 621.314.63 **3207**

Junction Diode A.F.C. Circuit.—G. G. Johnstone. (*Wireless World*, Aug. 1956, Vol. 62, No. 8, pp. 354–355.) A circuit intended primarily for a f.m. receiver uses a junction diode biased to cut-off; in this condition the diode capacitance varies with the applied voltage.

621.396.8 **3208**

Asymmetry in the Performance of High-Frequency Radiotelegraph Circuits.—A. M. Humby & C. M. Minnis. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 553–558.) A further study has been made of the systematic differences which have been observed previously in the performance of radiotelegraph circuits for transmission in the two opposite directions [3394 of 1955 (Humby et al.)]. Measurements on transequatorial circuits suggest that the asymmetry is due at least partly to the combined effects of using directive receiving aerials and the diurnal and seasonal changes in the sources of atmospheric noise.

621.396.82 : 621.327.43 **3209**

Evaluation of Radio Influence Voltages in Fluorescent Lighting Systems.—F. H. Wright & S. A. Zimmermann. (*Elect. Engng, N.Y.*, March 1956, Vol. 75, No. 3, pp. 272–274.) Interference with radio reception is caused mainly by supply-line radiation and by direct conduction. Elimination of interference by a low-impedance earth on the lighting system is unreliable; the connection of capacitors across individual lamps is most effective. In evaluating the efficiency of any filtering system a reference standard obtained by putting 0·01-μF capacitors across each lamp is recommended.

STATIONS AND COMMUNICATION SYSTEMS

621.376.56 **3210**

Coding of Signals by Damped-Oscillation Method.—B. Carniol. (*Slab. Obz., Prague*, March 1956, Vol. 17, No. 3, pp. 129–134.) A system of pulse coding which obviates the use of a coding tube is described. Voltage pulses of amplitudes proportional to the instantaneous amplitudes of the speech voltage, produced at intervals of 125 μs, excite an *LCR* circuit tuned to 500 kc/s. The resultant modulated voltage is passed through an amplitude limiter to a binary coder. Basic circuit diagrams of a simple coder and one with symmetrical logarithmic compression are given.

621.39 : 534.78 **3211**

The Vobanc—a Two-to-One Speech Bandwidth Reduction System.—Bogert. (See 2943.)

621.39.01 : 512.831 **3212**

Topological Properties of Telecommunication Networks.—Z. Prihar. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 927–933.) A method of matrix analysis developed in connection with sociological studies is applied to investigate problems relating to the connections between a number of points. Numerical examples are given.

621.396 **3213**

Symposium on Communications by Scatter Techniques.—(See 3185.)

621.396.41 + 621.395.43] : 621.376.3 **3214**

An Extended Analysis of Echo Distortion in the F.M. Transmission of Frequency Division Multiplex.—R. G. Medhurst & G. F. Small. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 447–448.) Discussion on 1867 of June.

621.396.41 : 621.376.3 **3215**

Multiprogram F.M. Broadcast System.—W. N. Hershfield. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 130–133.) A system is described in which three additional programs with bandwidth 10 kc/s are transmitted by f.m. on subcarriers 28, 49 and 67 kc/s above the main broadcast carrier. Detailed circuit diagrams are given of the subcarrier generator with serrasoid modulator, the transmitter exciter stage, the main-channel receiver and a subcarrier demodulator unit.

621.396.41.029.6 : 621.376.3 : 621.396.82 **3216**

Nonlinear Distortion in Multichannel Communication Systems with Frequency Modulation.—V. A. Smirnov. (*Radiotekhnika, Moscow*, Feb. 1956, Vol. 11, No. 2, pp. 14–28.) Noise due to multipath propagation and waveguide mismatch is considered theoretically. The results are more general than those obtained by Borovich (*ibid.*, Oct. 1955, Vol. 10, No. 10, pp. 3–14) and by Bennett et al. (3089 of 1955).

621.396.5 : 621.396.4 **3217**

The Copenhagen-Thorshavn Radiotelephony Link.—S. Gregersen. (*Teleteknik, Copenhagen*, Feb. 1956, Vol. 7, No. 1, pp. 15–34.) Detailed description of this h.f. multichannel system.

621.396.65 **3218**

V.H.F. Radio Link in the West Indies.—R. McSweeny. (*Elect. Engng, N.Y.*, March 1956, Vol. 75, No. 3, p. 271.) Digest of paper published in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, Jan. 1956, Vol. 74, pp. 781–785. Details are given of two radio links over 69 miles and 45 miles respectively, using f.m. transmissions on frequencies of 150–160 Mc/s.

621.396.7 + 621.397.7](47) **3219**

Broadcasting in the U.S.S.R.—(*Wireless World*, Aug. 1956, Vol. 62, No. 8, pp. 379–381.) Some technical details of the sound and vision services are given; with a note on the television standards.

621.396.7(492) : 621.376.3] + 621.397.7(492) **3220**

A Survey of the TV and F.M. Projects in the Netherlands.—J. L. Bordewijk. (*PTT-Bedrijf*, March 1956, Vol. 7, No. 1, pp. 1–12. In English.)

621.396.71(489) **3221**

Coast Stations in Denmark.—K. Svenningsen. (*Teleteknik, Copenhagen*, Feb. 1956, Vol. 7, No. 1, pp. 1–14.) The radio stations at Thorshavn, Skagen (The Skaw) and Rønne are described; telegraphy and telephony services are handled.

SUBSIDIARY APPARATUS

621-526 **3222**

An On-Off Servomechanism with Predicted Change-Over.—J. F. Coales & A. R. M. Noton. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 449–460. Discussion, pp. 460–462.) "A general method has been devised for achieving optimum switching with an on-off control system. The practicability of predicting the ideal switching time has been demonstrated with a model experiment for which responses to step, ramp, and parabolic input functions

have been found to compare favourably with those of an orthodox system."

621-526 **3223**

The Dual-Input Describing Function and its Use in the Analysis of Nonlinear Feedback Systems.—J. C. West, J. L. Douce & R. K. Livesley. (*Proc. Instn elect. Engrs*, Part B, July 1956, Vol. 103, No. 10, pp. 463–473. Discussion, pp. 473–474.)

621.3-71 : 537.32 : 537.311.33 **3224**

Thermoelectric Cooling.—L. S. Stil'bans, E. K. Iordanishvili & T. S. Stavitskaya. (*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Jan. 1956, Vol. 20, No. 1, pp. 81–88.) A brief account is given of A. F. Ioffe's theory of thermoelectric cooling (*Energetical Bases of Semiconductor Thermo-Batteries*, published by the U.S.S.R. Academy of Sciences, Moscow, 1956) and of experimental results. Temperature differences up to 70°C have been obtained. Applications being investigated include cooling of components in radio and electronic equipment.

621.314.63 : 546.28 **3225**

Diffused *p-n* Junction Silicon Rectifiers.—M. B. Prince. (*Bell Syst. tech. J.*, May 1956, Vol. 35, No. 3, pp. 661–684.) Development types with current ratings up to 100 A for reverse peak voltages of 200 V or over are described. Operation is satisfactory at temperatures up to 200°C.

621.314.63 : 546.28 **3226**

The Forward Characteristic of the P-I-N Diode.—D. A. Kleinman. (*Bell Syst. tech. J.*, May 1956, Vol. 35, No. 3, pp. 685–706.) Theory for the *p-i-n* Si diffused-junction diode indicates that the forward characteristic should be similar to that of the simple *p-n* diode until the current density approaches 200 A/cm²; anomalies in the characteristic at low current densities are unrelated to the presence of the weakly *p* middle region. See also 3225 above.

621.362 : 537.311.33 : 537.32 **3227**

Thermoelectric Generators.—A. F. Ioffe. (*Bull. Acad. Sci. U.R.S.S., sér. phys.*, Jan. 1956, Vol. 20, No. 1, pp. 76–80. In Russian.) Basic design formulae are given and discussed. Using a semiconductor layer 0·5 cm thick, with thermoelectric coefficient 170×10^{-6} V/deg, a temperature difference of 300°C across it, and a heat input of 11·6 W/cm², and assuming a specific mass of 5 and an efficiency of 8%, an output of 0·2 kW/kg may be obtained.

TELEVISION AND PHOTOTELEGRAPHY

621.397.611.2 : 525.623 : 621.397.7 **3228**

The 'Vitascan'—New Color TV Scanner.—C. E. Spicer. (*Tele-Tech & Electronic Ind.*, Feb. 1956, Vol. 15, No. 2, pp. 60–61, 117.) A spot of white light, generated on the screen of a c.r. tube by a beam deflected at the standard television rate, is projected on the scene and the reflected light is picked up by fixed photo-multiplier tubes, associated with colour filters, which generate the video signal. General studio lighting is provided by pulsing xenon lamps to be on during the vertical retrace time of the television signal.

621.397.62 + 621.396.621 **3229**

Preventing Fires from Electrical Causes in the Design and Manufacture of Radio and Television Receivers.—H. T. Heaton. (*Trans. Inst. Radio Engrs*, April 1955, Vol. BTR-1, No. 2, pp. 28–36.)

621.397.62 **3230**

A Television Receiver Suitable for Four Standards.—H. L. Berkhout. (*Philips tech. Rev.*, Dec. 1955, Vol. 17, No. 6, pp. 161–170.) A model suitable for receiving the Belgian 625- and 819-line, the European 625-line, and the French 819-line standards is described. A common vision i.f. amplifier is used, the frequency being 38·9 Mc/s and the bandwidth 4 Mc/s. The video signal is applied to the picture-tube control grid for positive modulation and to the cathode for negative modulation. Different sound intermediate frequencies are again converted to a common second i.f. of 7 Mc/s. Flywheel synchronization is used for the horizontal deflection.

621.397.62 : 525.623 **3231**

Chrominance Circuits for Colour-Television Receivers.—B. W. Osborne. (*Electronic Engng*, June & July 1956, Vol. 28, Nos. 340 & 341, pp. 240–246 & 293–297.) "A survey of current practice and recent developments in phase synchronization, chrominance demodulator and matrix circuits for use in colour-television receivers."

621.397.621 : 535.623 : 621.385.832 **3232**

Television Receiver uses One-Gun Color C.R.T.—(*Electronics*, June 1956, Vol. 29, No. 6, pp. 150–153.) A description is given of the 'apple' tube. An electron beam sequentially strikes vertical phosphor stripes arranged in triplets of red, blue and green on an aluminized screen, with interstices filled with non-luminescent material. Applied behind each red stripe and covering about 40% of the triplet width is an 'indexing' stripe of MgO with high secondary-emission characteristic. An intensity-modulated pilot beam from the same electron gun is aligned so that it strikes the same colour stripe as the main beam, and the secondary-emission current is used to derive an indexing signal controlling the amplitude and phase modulation of the main signal to produce a colour display. Block diagrams and some details of the associated receiver circuit are given.

621.397.7 **3233**

Optical Multiplexing in Television Film Equipment.—A. H. Lind & B. F. Melchionni. (*J. Soc. Mot. Pict. Telev. Engrs*, March 1956, Vol. 65, No. 3, pp. 140–145. Discussion, p. 145.)

621.397.7 + 621.396.7](47) **3234**

Broadcasting in the U.S.S.R.—(See 3219.)

621.397.7(492) + (621.396.7(492) : 621.376.3 **3235**

A Survey of the TV and F.M. Projects in the Netherlands.—J. L. Bordewijk. (*PTT-Bedrijf*, March 1956, Vol. 7, No. 1, pp. 1–12. In English.)

621.397.8 : 621.372 : 621.3.018.752 **3236**

The Effect upon Pulse Response of Delay Variation at Low and Middle Frequencies.—Callendar. (See 2984.)

TRANSMISSION

621.376.22 : 621.317.6 : 621.385.5 **3237**

Study of Amplitude Modulation applied via a Pentode Suppressor Grid.—J. Loeckx. (*Rev. HF, Brussels*, 1956, Vol. 3, No. 5, pp. 183–190.) With this method of modulation, the pentode screen grid is maintained at fixed potential. The relation between the anode current and the grid and anode voltages is derived, and the equation of the modulation characteristic is hence determined explicitly. A measurement method particularly suitable for obtaining the characteristics of power valves is outlined.

621.396.61 : 621.396.662 **3238**

Automatic Tuning for High-Power Transmitter.—V. R. DeLong. (*Electronics*, July 1956, Vol. 29, No. 7, pp. 134–137.)

VALVES AND THERMIONICS

621.314.63(47) : 546.289 **3239**

Germanium Diodes.—A. N. Puzhai. (*Avtomatika i Telemekhanika*, Feb. 1956, Vol. 17, No. 2, pp. 140–146.) Discussion of the characteristics of point-contact and junction-type Ge diodes available in Russia.

621.314.632 : 546.289 **3240**

Effect of Vacuum Heating and Ion Bombardment of Germanium on Point Contact Rectification.—R. B. Allen & H. E. Farnsworth. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 525–529.) Measurements were made of the characteristics of diodes comprising a Ge crystal with a tungsten or columbium point contact, to determine whether an adsorbed gas layer on the Ge surface is a pre-requisite for rectification. Ge surfaces free from such layers are obtained by vacuum heating and argon-ion bombardment. The best rectification characteristics were obtained after the Ge had been subjected to a long anneal, argon-ion bombardment, and a short anneal, in that order. The diode activation potential does not appear to be dependent on the metallic work function.

621.314.7(083.7) **3241**

I.R.E. Standards on Letter Symbols for Semiconductor Devices, 1956.—(*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 824–937.) Standard 56 I.R.E. 28. Sl on transistors.

621.314.7.002.2 **3242**

Automatic Etching of Transistor Pellets.—(*Electronics*, July 1956, Vol. 29, No. 7, pp. 226..236.) A description of the etching, washing and indium plating of concentric holes in Ge or Si pellets for surface-barrier transistors. The precision electrochemical etching is controlled by a light beam and photocell.

621.314.7 : 537.311.33 **3243**

Propagation of a Short Pulse in a Semiconductor bounded by Two Electron-Hole Transitions.—E. I. Adirovich & V. G. Kolotilova. (*Zh. eksp. teor. Fiz.*, Dec. 1955, Vol. 29, No. 6(12), pp. 770–777.) The propagation of a short pulse in a *p-n-p* transistor is considered theoretically. Using the continuity equation for holes, an expression is derived for the concentration of non-equilibrium carriers at an arbitrary cross-section due to application of the pulse at the emitter. The collector current is calculated for various values of lifetime of the nonequilibrium carriers, and the effect of the boundary conditions on the electron processes in the body of the semiconductor is discussed.

621.314.7 : 621.318.57 **3244**

A Switching Transistor with Short Transition Times.—H. Salow & W. v. Münch. (*Z. angew. Phys.*, March 1956, Vol. 8, No. 3, pp. 114–119.) A characteristic with an unstable region is obtained by adding an auxiliary collector adjacent to the usual collector of a junction transistor. In an experimental *n-p-n* unit with base thickness of 50 μ, a change of emitter/base resistance from 1 MΩ to 20 Ω was achieved in 2×10^{-7} s. The theory and the characteristics are discussed.

621.314.7 : 621.387.4 **3245**

The Application of Transistors to the Trigger, Ratemeter and Power-Supply Circuits of Radiation Monitors.—Franklin & James. (See 3175.)

621.314.7 : 621.396.822 **3246**

Microphonism due to Transistor Leads.—C. W. Durieux & T. A. Prugh. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 938–939.) A brief note of observations of voltages generated by the vibrations of transistor leads in a magnetic field.

621.38.004.6 **3247**

Reliability as a Design and Maintenance Problem.—R. Matthews. (*Electronic Engng*, July 1956, Vol. 28, No. 341, pp. 310–312.) The subject is discussed particularly in relation to valve performance.

621.383.27 : 621.387.464 **3248**

Study of the First-Stage Focusing of a Photomultiplier Tube for Scintillation Counting.—G. Wendt. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 372–386.)

621.383.4 **3249**

The Photo-effect in Lead Sulphide and Related Materials.—R. Stein & B. Reuter. (*Z. Naturf.*, Aug. 1955, Vol. 10a, No. 8, pp. 655–656.) Discussion of photoelectric inertia effects which have been traced to the presence of excess sulphur. Experiments are reported which indicate that these effects are probably related to the sensitization of the PbS cell by the usual method involving oxidation.

621.383.4/5 : 546.817.221 **3250**

***p-n* Junctions in Photosensitive PbS Layers.**—J. Bloem. (*Appl. sci. Res.*, 1956, Vol. B6, Nos. 1/2, pp. 92–100.) PbS layers containing sharp *p-n* junctions can be produced by precipitation from an aqueous solution on to a glass plate partially coated with a thin layer of a trivalent metal; immediately after deposition, the whole of the PbS layer is of *n* type, but the portion on the uncoated glass is converted to *p* type soon after coming into contact with the air. Measurements of the photo-e.m.f. and resistance of such cells are reported; variations with storage time were investigated. The influence of oxygen in the ambient gas is discussed.

621.383.5 **3251**

The Photo-Electromotive Force of Lead Sulphide Photocells.—R. Ya. Berlaga, M. A. Rumsh & L. P. Strakhov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1878–1882.) Layers of PbS were obtained in which an e.m.f. appeared during illumination, although no voltage was applied during their preparation. The photo-e.m.f. of freshly prepared specimens was of the order of a few mV. When the specimens were heated to temperatures between 500° and 600°C, the photo-e.m.f. increased to 3 V. The experimental investigation is described, electron-diffraction diagrams are reproduced, and a theoretical interpretation of the results is given.

621.385.029.6 **3252**

Theory of the Transverse-Current Travelling-Wave Tube.—D. A. Dunn, W. A. Harman, L. M. Field & G. S. Kino. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 879–887.) Valves are discussed in which an extended beam approaches the helix from the side, either normally or at an angle; each electron, instead of travelling the length of the helix, cuts across it and interacts with it for only a fraction of its length. Three forward waves are produced in such a system. Expressions are derived for the overall gain. The power output reaches saturation for a given value of input and stays at this value with further increase of input.

621.385.029.6 **3253**

An Experimental Transverse-Current Travelling-Wave Tube.—D. A. Dunn & W. A. Harman. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 888–896.) Details are given of the construction and performance of a valve of the class discussed by Dunn et al. (3252 above) using a flat helix and a skew beam. The valve operates as an amplifier over the frequency range 1–2 kMc/s with a power output of the order of 30 mW. The gain/voltage characteristic is markedly different from that of a conventional travelling-wave valve; high attenuation is observed over a wide range of current and voltage values. Gain/current, gain/frequency and saturation-power/frequency characteristics are as predicted by the theory. Experiments are described in which two input signals of different frequencies were applied simultaneously.

621.385.029.6 **3254**

Some Effects of Magnetic Field Strength on Space-Charge-Wave Propagation.—G. R. Brewer. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 896–903.) General analysis is presented for the propagation of space-charge waves in magnetically focused electron beams. The propagation characteristics for the fundamental radial mode are expressed in terms of the plasma-frequency reduction factor, graphs of which are shown. The case of a beam within a helix, as in the travelling-wave valve, is examined particularly.

621.385.029.6 **3255**

Study of the Oscillation Modes of the M-Type Carcinotron: Part I.—M. de Bennetot. (*Ann. Radioélect.*, Oct. 1955, Vol. 10, No. 42, pp. 328–343.) The starting current and oscillation frequency are determined theoretically, taking account of space-charge effects. The field of the space harmonic interacting with the electron beam in this case is constituted by the sum of three travelling waves.

621.385.029.6 : 621.316.726 : 621.396.96 **3256**

Klystron Control System.—Reeves. (See 3068.)

621.385.029.6 : 621.396.822 **3257**

A Dip in the Minimum Noise Figure of Beam-Type Microwave Amplifiers.—P. K. Tien. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, p. 938.) A detailed computation has been made of the fluctuations of electron current and velocity at the potential minimum of a particular valve. The results indicate that the velocity fluctuation is not smoothed and the fluctuations of current and velocity are not correlated. A physical explanation is given of the resulting shape of the cumulative autocorrelation curve. The minimum noise figure for a typical travelling-wave valve as calculated from this autocorrelation curve shows a dip at about 2·5 kMc/s and a peak at about 4 kMc/s.

621.385.029.6.032.21 : 536.52 **3258**

A New Method for the Measurement of Rapid Fluctuations of Temperature.—R. Dehn. (*Brit. J. appl. Phys.*, April 1956, Vol. 7, No. 4, pp. 144–148.) Instantaneous changes in cathode surface temperature in an oscillating magnetron are displayed and measured as pulses on a c.r.o. screen by means of an infrared-image converter and photomultiplier. The instrument is calibrated against an optical pyrometer; changes of 2°C at 900°C have been detected.

621.385.032.21 : 537.58 **3259**

Thermionic Emission Properties of Thin Films of Thorium Oxide and Thorium on Metallic Bases.—A. R. Shul'man & A. P. Rumyantsev. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 11, pp. 1898–1909.) Report on an experimental investigation of thin films of ThO_2 and Th deposited on Mo and Pt bases. The deposition of the films is described in detail and a large number of experimental curves are given. The results are discussed and various suggestions regarding the mechanism of thermionic emission are made.

621.385.032.216 **3260**

Radioactive Isotope Study of the Dissociation of Barium Oxide under Electron Bombardment.—S. Yoshida, N. Shibata, Y. Igarashi & H. Arata. (*J. appl. Phys.*, May 1956, Vol. 27, No. 5, pp. 497–500.) Measurements are reported of the rate of evolution of Ba; the number of Ba atoms produced per bombarding electron is plotted as a function of bombarding-electron voltage and of oxide temperature. The results are qualitatively similar to those for SrO (*J. phys. Soc. Japan*, July/Aug. 1954, Vol. 9, No. 4, pp. 640–641); discussion indicates that they can be reconciled with those of Leverton & Shepherd (3601 of 1952).

621.385.132 : 681.142 **3261**

Binary Adder uses Gas-Discharge Triode.—F. B. Maynard. (*Electronics*, June 1956, Vol. 29, No. 6, pp. 196..202.) The elementary triode cell has a large-area cathode and closely overlaid anode element of fine wire. A probe element in the upper part of the cathode glow, common to a number of cells, acquires a positive charge. The voltage excursion at the probe can be as much as 30 V without causing a discharge in cells other than that actuated. Experimental valves with a matrix of 30 of these cells have been tested.

621.385.5.032.24 : 621.374.3 **3262**

A New High-Slope Multigrid Valve and its Application in Pulse and Switching Circuits.—K. Gosslau & W. Guber. (*Frequenz*, March 1956, Vol. 10, No. 3, pp. 83–89.) An experimental heptode Type-V108 with three frame grids had slopes of 13 and 7·5 mA/V respectively at the two control grids, high pulse current intensity, and adequate loading capacity at the first screen grid. A pulse distributor using this valve is described.

621.385.832 : 621.397.621 : 535.623 **3263**

Television Receiver uses One-Gun Color C.R.T.—(See 3232.)

MISCELLANEOUS

061.6 : 621.396 **3264**

International Cooperation in Radio Research—U.R.S.I. and I.R.E.—J. H. Dellinger. (*Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 866–872.) The internal structure of the International Scientific Radio Union is described, and its relations with the C.C.I.R. and the I.R.E. are explained.

621.3 : 537 **3265**

Advances in Electronics and Electron Physics, Vol. VII. [Book Review]—L. Marton (Ed.). Publishers: Academic Press, New York, 1956, 503 pp., $11.50. (*Proc. Inst. Radio Engrs*, June 1956, Vol. 44, No. 6, Part 1, pp. 828–829.) Review articles are presented on the physics of semiconductor materials, theory of electrical properties of Ge and Si, energy losses of electrons in solids, sputtering by ion bombardment, observational radio astronomy, analogue computers, and electrical discharge in gases and modern electronics.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.232 **3266**

Emission of Sound by a Rotating Dipole.—L. N. Sretenski. (*Akust. Zh.*, Jan.–March 1956, Vol. 2, No. 1, pp. 93–98.) A theoretical paper.

534.232 : 621.395.623.7 **3267**

The Generation of Sound Pulses for Acoustic Measurements by means of Loudspeakers.—H. Niese. (*Hochfrequenztech. u. Elektroakust.*, Nov. 1955, Vol. 64, No. 3, pp. 84–90.) The production of pulses with desired waveforms is discussed. A special loudspeaker with a spherical radiation pattern has been developed to simulate the sound from an orchestra.

534.24 : 534.861 **3268**

Wobbling of an Audio Note due to a Rotating Target.—M. V. J. Row & S. R. Rao. (*J. Instn Telecommun. Engrs, India*, March 1956, Vol. 2, No. 2, pp. 100–102.) Analysis is presented of the frequency rise and fall of an initially steady tone after reflection of the sound wave from a rotating target. The theory is relevant to effects which might be produced by a fan operating in a studio.

534.26 **3269**

Diffraction by a Cylinder of Finite Length.—W. E. Williams. (*Proc. Camb. phil. Soc.*, April 1956, Vol. 52, Part 2, pp. 322–335.) The diffraction of a plane sound wave by a hollow cylinder is considered. Laplace transforms are used, and the problem is reduced to the solution of two complex integral equations. The solution is finite for all values of the cylinder length, including those corresponding to resonance conditions.

534.31 **3270**

The Transient State resulting from the Excitation of a String by a Bow.—B. Bladier. (*C. R. Acad. Sci., Paris*, 4th June 1956, Vol. 242, No. 23, pp. 2704–2707.)

534.79 **3271**

A Re-determination of the Equal-Loudness Relations for Pure Tones.—D. W. Robinson & R. S. Dadson. (*Brit. J. appl. Phys.*, May 1956, Vol. 7, No. 5, pp. 166–181.) Report of an investigation carried out at the National Physical Laboratory. Subjective measurements were made at frequencies in the range 25 c/s – 15 kc/s and at sound pressure levels up to about 130 dB above 0·0002 dyn/cm². A new determination was made of the normal threshold of hearing in free field; the results are highly consistent with the equal-loudness contours. Discrepancies between results obtained previously by various workers are to some extent explained.

534.844 **3272**

Note on the Statistical Treatment of the Reverberation Process.—W. Kraak. (*Hochfrequenztech. u. Elektroakust.*, Nov. 1955, Vol. 64, No. 3, pp. 90–93.) The validity of formulae derived by Eyring (*J. acoust. Soc. Amer.*, Jan. 1930, Vol. 1, pp. 217–241) for a nonuniform distribution of absorptive material is confirmed.

534.86 : 621.375.4.029.3 **3273**

Transistor Preamps.—Starke. (See 3323.)

534.862.6 **3274**

Calculation of the Audibility of Nonlinear Distortion originating in an Electroacoustic System.—A. V. Rimski-Korsakov. (*Akust. Zh.*, Jan.–March 1956, Vol. 2, No. 1, pp. 51–61.) The probability is calculated of the products of nonlinear distortion in a sound-reproducing channel exceeding the masking level due to the fundamental signal and the threshold of audibility in the auditorium. In the particular case of a signal with a flat frequency spectrum distorted by a square-law nonlinearity, the threshold of perceptibility of the distortion corresponds to a harmonic coefficient of between 2% and 3%.

621.395.614 : 546.431.824-31 **3275**

Nondirectional Ceramic Sound Receivers.—A. A. Anan'eva. (*Akust. Zh.*, Jan.–March 1956, Vol. 2, No. 1, pp. 10–27.) The characteristics of cylindrical and spherical $BaTiO_3$ microphones were investigated experimentally at frequencies up to several hundred kc/s. Experimental results are presented graphically, in tabular form and in 78 oscillograms of the polar characteristics.

AERIALS AND TRANSMISSION LINES

621.372.2 **3276**

Propagation of Waves along an Infinitely Long Helix.—N. N. Smirnov. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1956, Vol. 108, No. 2, pp. 243–246. In Russian.) The dispersion equation is discussed theoretically.

621.372.22 : 621.372.51 **3277**

Impedance Transformers.—J. Willis & N. K. Sinha. (*Wireless Engr*, Sept. 1956, Vol. 33, No. 9, pp. 204–208.) Experimental work is reported on nonuniform-transmission-line devices previously discussed theoretically (1614 of June). A compensated coaxial-line-resistor termination designed to give negligible reflection over a wide band is described. Observed and calculated reflection patterns for two types of tapered line are compared. Attenuation effects are negligible in practical cases.

621.372.43 **3278**

The Optimum Tapered Transmission-Line Matching Section.—R. W. Klopfenstein: E. F. Bolinder: R. E. Collin. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1055–1056.) Comments on 1953 of July and author's reply.

621.372.8 **3279**

Production of Slow Electromagnetic Waves by means of Cylindrical Current Sheets.—F. Bertein & W. Chahid. (*C. R. Acad. Sci., Paris*, 18th June 1956, Vol. 242, No. 25, pp. 2918–2920.) Brief discussion of possible modes with waves slowed by complex helix structures; the mathematical analysis assumes a continuous conducting surface.

621.372.8 **3280**

Propagation of Electromagnetic Waves between Two Circular Cylindrical Surfaces in the Presence of Longitudinal, Periodically Spaced Diaphragms.—E. G. Solov'ev. (*Radiotekhnika, Moscow*, Jan. 1956, Vol. 11, No. 1, pp. 57–60.) Analysis is given for an E wave travelling circumferentially between a pair of coaxial cylindrical sheets with diaphragms spaced along the coaxial mid-surface. Comparison of the results with those obtained earlier (978 of April) indicates that for wavelengths very much longer than the diaphragm space period, the phase velocity is reduced by the diaphragm system and a large number of space harmonics are produced; the higher their number the lower their phase velocity. This suggests use of systems of this type for delay lines.

621.396.676 : 621.396.933 **3281**

TACAN Radio Bearing and Distance System for Aerial Navigation.—(See 3386.)

621.396.677 : 621.396.97 **3282**

Vertical Radiation and Tropical Broadcasting.—Dickinson. (See 3536.)

621.396.677.8 : 621.396.65.029.63 **3283**

A Decimetre-Wavelength Radio-Link Network providing High-Quality Program Channels using Pulse Phase Modulation: Part 2—Aerial Installations.—E. Schüttlöffel. (*Telefunken Ztg*, March 1956, Vol. 29, No. 111, pp. 12–20. English summary, p. 63.) Parabolic reflector aerials with dipole exciters are used, with auxiliary deviating reflectors at one point. Part 1: 3534 below.

AUTOMATIC COMPUTERS

016 : 681.142 **3284**

Bibliography of Literature on Mathematical Simulation (Analogue Computers) (1947–1954).—(*Avtomatika i Telemekhanika*, March & April 1956, Vol. 17, Nos. 3 & 4, pp. 279–288 & 268–383.) About 500 items are listed, including books, conference reports, and papers. About 70 references are to Russian literature.

681.142 **3285**

Electronic Differential Analyser of the G.M. Krzhizhanovski Energetics Institute of the U.S.S.R. Academy of Sciences.—I. S. Bruk & N. N. Lenov. (*Avtomatika i Telemekhanika*, March 1956, Vol. 17, No. 3, pp. 217–227.) The analyser comprises 38 operational amplifiers, four multipliers and four function transformers with a harmonics generator. The basic circuits are described. Differential equations up to the 19th order have been solved; equations up to the 25th order could be handled.

681.142 **3286**

Magnetic Shift-Register Correlator.—R. C. Kelner & M. H. Glauberman. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 172–175.) "Printed decimal digits 0 to 9 are easily recognized by a magnetic-shift register using digital-to-analog converters at each stage. Recognition is obtained using a waveform-fitting function instrumented with the shift-register for correlation."

681.142 **3287**

Triangular-Wave Analog Multiplier.—R. A. Meyers & H. B. Davis. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 182–185.)

681.142 **3288**

High-Density Williams Storage.—S. Y. Wong. (*Trans. Inst. Radio Engrs*, Dec. 1955, Vol. EC-4, No. 4, pp. 156–158. Abstract, *Proc. Inst. Radio Engrs*, April 1956, Vol. 44, No. 4, p. 580.)

681.142 : 621.383.2 **3289**

Bit Storage via Electro-optical Feedback.—A. Milch. (*Trans. Inst. Radio Engrs*, Dec. 1955, Vol. EC-4, No. 4, pp. 136–144.) The use of a device including a photoemissive cathode and a luminescent anode as a computer component is discussed.

CIRCUITS AND CIRCUIT ELEMENTS

621.3-71 **3290**

Review of Industrial Applications of Heat Transfer to Electronics.—J. Kaye. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 977–991.) Techniques for controlling the temperature conditions of operation of electronic equipment are reviewed with particular reference to conditions in fast aircraft and missiles. Particular examples discussed are (*a*) an air-cooled 25-kW valve [*Trans. Inst. Radio Engrs*, April 1954, Vol. ED-1, pp. 9–26 (London)], (*b*) cold-plate techniques for cooling miniature and subminiature equipment, (*c*) valves designed for operation at surface temperatures near 500°C, and (*d*) evaporation cooling of miniature transformers by means of fluorochemicals. The importance of the subject of heat transfer to designers of electronic equipment is stressed, and training programs at the Massachusetts Institute of Technology are mentioned.

621.3.6.546 : 621.3.018.756 **3291**

Fast-Rise Pulse Generator with High Pulse Repetition Frequency.—C. G. Dorn. (*Rev. sci. Instrum.*, May 1956, Vol. 27, No. 5, pp. 283–284.) Description of a single-pole multi-position switch in

which mercury is ejected through a rotating nozzle on to a series of contact pins, thus generating pulses having a rise time $< 0{\cdot}002\,\mu s$, at repetition rates > 10 kc/s, with peak pulse power of 50 W.

621.316.82 **3292**

On Concavity of Resistance Functions.—H. M. Melvin. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 658–659.) A short proof is given of a theorem presented by Shannon & Hagelbarger (1635 of June).

621.318.424 **3293**

Ferromagnetic Coupling between Crossed Coils.—U. F. Gianola & D. B. James. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 608–609.) Discussion of the operation of devices comprising e.g. a toroidal and a solenoidal coil wound on a common cylindrical saturated ferromagnetic core; gating, coincidence and signal storage applications are mentioned.

621.319.4 **3294**

Self-Healing in Metallized Paper Capacitors.—C. B. Charlton. (*TMC tech. J.*, March 1955, Vol. 6, No. 1, pp. 27–41.) The physical and manufacturing techniques involved in the production of truly self-healing single-layer metallized-paper capacitors are described.

621.372.4 **3295**

Decomposition of the Derivative of the Impedance for a Two-Terminal Network.—L. Lunelli. (*Alta Frequenza*, April 1956, Vol. 25, No. 2, pp. 152–159.) Extension of theory presented previously (3183 of 1955).

621.372.54 **3296**

Design Data for Ladder Networks.—E. Green. (*Marconi Rev.*, 2nd Quarter 1956, Vol. 19, No. 121, pp. 78–88.) Design data for networks with up to nine branches and attenuation curves for networks with up to eleven branches are presented in expansion of previous work (1267 of 1953 and 2563 of 1955).

621.372.54.029.6 **3297**

Directional Channel-Separation Filters.—S. B. Cohn & F. S. Coale. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1018–1024.) Networks are discussed which combine the properties of directional couplers with those of conventional filters; such networks are useful for channel combining and separating in microwave communication systems and in installations where a single aerial is shared by several systems. Designs using waveguides, coaxial and strip lines and lumped-constant circuits are indicated; the performance of some experimental filters is described.

621.372.542.21 **3298**

Low-Pass Filters for Metre Waves.—O. Guarracino. (*Alta Frequenza*, April 1956, Vol. 25, No. 2, pp. 161–168.) Filters intended for suppression of harmonics in m-λ measurements, and having cut-off frequencies of about 100–300 Mc/s, comprise three LC II sections with lumped-constant components. The construction and method of adjustment are described.

621.372.543.2 **3299**

A Low-Pass/Band-Pass Frequency Transformation.—K. B. Irani. (*Commun. News*, April 1956, Vol. 16, No. 3, pp. 99–104.) A simple transformation is presented for converting a low-pass insertion-power ratio into a band-pass ratio; the technique facilitates the design of band-pass filters when the attenuation curves on either side of the pass band are required to be asymmetrical.

621.372.56.029.6 : 621.318.134 **3300**

A Unidirectional Attenuator with Delay Line and Ferrite Element for the 4-Gc/s Frequency Band.—W. Eichin. (*Nachrichtentech. Z.*, April 1956, Vol. 9, No. 4, pp. 168–172.) The attenuation afforded by various devices comprising ferrite tubes surrounding helical lines and in turn surrounded by tubular magnets was investigated experimentally; results are presented graphically. The attenuation obtained with the final design was about 1 dB in the forward direction and 20 dB in the blocking direction.

621.372.6 : 621.318.134 **3301**

Frequency Doubling and Mixing in Ferrites.—J. E. Pippin. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1054–1055.) Analysis is presented indicating the particular polarization and frequency conditions under which frequency doubling and mixing will occur in ferrite devices of the type discussed by Ayres et al. (2138 of July).

621.372.6.012 **3302**

The Derivation of the Six-Terminal-Network Curve, its Graphical Interpretation and its Application in determining the Transformation Properties of Loss-Free Six-Terminal and Eight-Terminal Networks.—H. Lueg. (*Arch. elekt. Übertragung*, April 1956, Vol. 10, No. 4, pp. 151–162.)

621.373 **3303**

Tuned Circuits containing Negative Resistance.—J. Gross. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 603–607.) Analysis indicates that the combination of a current-controlled negative resistance with a parallel-tuned circuit, or of a voltage-controlled negative conductance with a series-tuned circuit yields a bistable circuit rather than a self-sustaining oscillator.

621.373.42 : 621.396.61 : 621.376.32 **3304**

The Gain Characteristic inside the Pull-In Range particularly in F.M. Transmitters and Wobbulators.—Woschni. (See 3560.)

621.373.42.016.35 **3305**

Oscillator Frequency Stability.—A. S. Gladwin. (*Wireless Engr*, Sept. 1956, Vol. 33, No. 9, pp. 209–220.) The case of an oscillator connected to a mismatched load by a long feeder is considered. In addition to hysteresis effects, with resonant loads a type of instability occurs which takes the form of a periodic modulation of the oscillation frequency (see also 54 of January). Stability criteria appropriate to both effects are derived for various circuit arrangements. Results of experiments with a triode oscillator operating at 10 Mc/s are reasonably consistent with the theory. In general, the hysteresis type of instability predominates.

621.373.421.11 **3306**

Novel Circuit for a Stable Variable-Frequency Oscillator.—D. Makow. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1031–1036.) A circuit designed to reduce the effect of resonator frequency drift uses a multiloop feedback arrangement with three oscillators maintained at frequencies such that one is the sum of the other two, the sum frequency being controlled by a quartz crystal while the other two are controlled by variable LC resonators. The circuit and frequency-drift/temperature characteristics of an experimental oscillator are shown.

621.373.431.2 : 621.396.96 **3307**

'Hard-Tube' Pulsers for Radar.—H. A. Reise. (*Bell Lab. Rec.*, April 1956, Vol. 34, No. 4, pp. 153–156.) Developments in design of high-vacuum valves make possible the construction of blocking-oscillator pulse

modulators comparable in size and efficiency with line-type thyratron modulators, with advantages in stability resulting from the pulse shape.

621.373.5 : 621.314.7 **3308**

Current-Derived Resistance-Capacitance Oscillators using Junction Transistors.—D. E. Hooper & A. E. Jackets. (*Electronic Engng*, August 1956, Vol. 28, No. 342, pp. 333–337.) Two circuits using 180°-phase-shift networks, suitable for use at very low frequencies, and one with a 0°-phase-shift network, giving a maximum frequency of 30 kc/s, are described.

621.374 **3309**

Pulse Scaler Circuit with High Resolving Power.—U. Pellegrini. (*Alta Frequenza*, April 1956, Vol. 25, No. 2, pp. 130–139.) A circuit with a resolving time of 5×10^{-8}s is based on a step-by-step capacitor charge and a rapid discharge process. The scaling factor can be varied from 2 to 10 without loss of stability. As a frequency divider, the circuit is limited to the range 200 kc/s – 20 Mc/s. Input pulses must be at least 2 V peak-to-peak.

621.374.3/.4 **3310**

High-Frequency Electronic Counter.—A. V. Lord & S. J. Lent. (*Wireless Engr*, Sept. 1956, Vol. 33, No. 9, pp. 220–226.) A circuit suitable for the frequency divider following the 2–4-Mc/s subcarrier generator in a colour-television receiver is based on a triggered binary cascade with feedback. The high counting rate is achieved by incorporating a gating arrangement.

621.374.3 : 621.375.2 **3311**

An Input Amplifier for a Pulse-Height Analyser.—A. Folkierski. (*J. sci. Instrum.*, May 1956, Vol. 33, No. 5, pp. 187–191.) The analyser described can be gated by pulses coincident with the pulses to be measured, the error introduced being $< 1\%$ of the maximum output pulse height. Variation of the input amplification enables the scale to be expanded for detailed examination of part of a spectrum.

621.374.32 : 621.318.57 **3312**

A Nine's-Complement Decade Counter with Recorder.—J. A. Phillips. (*Electronic Engng*, August 1956, Vol. 28, No. 342, pp. 344–349.) "A brief outline of decimal counting using weighted binary digits is given with special reference to systems giving complements of nine. A binary decade electronic counter arranged so as to allow the reading of nine's complements, which may be used to represent negative numbers is then described. In the circuit arrangement used in this counter the maximum counting rate remains the same as that of a simple binary counter. Recording of the number counted is made on 'Teledeltos' paper, the record and counter reset being carried out simultaneously."

621.374.33 **3313**

Gate selects Pulses for Spectrum Analysis.—A. Ross & L. Simon. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 179–181.) A circuit permitting isolation of pulses from 0·2 to 150 μs wide, at repetition rates up to 10 000 per sec, is described.

621.375.2 **3314**

Nonlinear Distortion and Stability of Reflex Circuits.—Yu. A. Chernov. (*Radiotekhnika, Moscow*, Jan. 1956, Vol. 11, No. 1, pp. 17–31.) Two single-valve and three two-valve h.f.-crystal-detector-l.f. reflex amplifier circuits are discussed. The coefficient of nonlinear distortion, k_f, is calculated for the various circuits and the results are plotted (fig. 5) as a function of the parameter αA, the relative change of slope of the I_A/V_g curve from the value at the working point, due to the applied l.f. signal; k_f can theoretically be made zero by using a pair of identical valves in the circuit shown in fig. 4. The stability criteria are also discussed.

621.375.2.024 **3315**

D.C. Decade Amplifier.—W. G. Royce & W. D. Mathews. (*Tele-Tech & Electronic Ind.*, April 1956, Vol. 15, No. 4, pp. 90–91 . . 157.) The circuit incorporates *RC* and direct-coupled stages and a chopper stabilizing amplifier, giving a bandwidth of 0–100 kc/s, with a gain of 0–60 dB in 20-dB steps. The equivalent input d.c. drift is $\gtrsim 10\,\mu$V; output is up to $\pm$ 35 V and $\pm$ 20 mA.

621.375.2.024 : 621.376.332 **3316**

Isolating Direct-Current Amplifiers.—A. Chevallier & B. Prokocimer. (*Rev. gén. Elect.*, April 1956, Vol. 65, No. 4, pp. 199–203.) A circuit providing an output direct current or voltage proportional to an input direct voltage, and having no common point between input and output, uses a fixed-frequency crystal-controlled oscillator in conjunction with a discriminator whose phase is varied by means of an electromechanical modulator which converts the input signal into a capacitance variation. Several applications are mentioned.

621.375.221.029.5 **3317**

Wide-Band Linear R.F. Amplifier.—B. F. Davies. (*Wireless World*, Aug. & Sept. 1956, Vol. 62, Nos. 8 & 9, pp. 374–378 & 446–449.) The amplifier described is designed for use with a common aerial to provide a distribution system for a ship. Frequency coverage is 150 kc/s–25 Mc/s with suppression in the 400–535-kc/s and 1·6–3·8-Mc/s bands, nominal gain is 15 dB. Performance figures are given; the level of intermodulation and cross-modulation products is low.

621.375.226 **3318**

Synthesis of Amplifiers with Triple-Tuned Coupled Circuits.—A. Smolinski. (*Archiwum Elektrotech.*, 1955, Vol. 4, No. 1, pp. 35–64. English summary, pp. 63–64.)

621.375.23.024 : 621.317.725 **3319**

Unity-Gain Voltmeter Amplifier.—Hyder. (See 3485.)

621.375.3 : 621.318.435 **3320**

Behaviour of Saturable Reactors in Magnetic Amplifiers.—P. N. Das. (*Indian J. Phys.*, March 1956, Vol. 39, No. 3, pp. 129–142.) A detailed analysis is presented of the behaviour of a magnetic amplifier in which the core material is assumed to have a square B/H characteristic. Systems with single cores, two series-connected cores and two parallel-connected cores are considered, with d.c. sources of (*a*) infinite and (*b*) low impedance. Results are presented graphically; supporting experimental evidence is mentioned briefly.

621.375.4 : 621.314.7 **3321**

Measurement Considerations in High-Frequency Power Gain of Junction Transistors.—Pritchard. (See 3566.)

621.375.4 : 621.396.96 **3322**

Transistor Amplifier for Radar Video.—R. Leslie. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 142–145.) The design of a video amplifier using Si transistors, suitable for airborne radar systems, is discussed. High-frequency compensation is obtained by *RC* degenerative feedback in a grounded-emitter circuit with temperature stabilization of emitter-current bias.

621.375.4.029.3 : 534.86 **3323**

Transistor Preamps.—H. F. Starke. (*Audio*, April 1956, Vol. 40, No. 4, pp. 31–32..73.) Discussion of practical design considerations for pre-amplifiers for use (*a*) with gramophones with a boosted low-frequency response and a flat-response main amplifier, and (*b*) with microphones, the pre-amplifier in this case having a flat response.

621.375.4.029.3 : 621.314.7 **3324**

A 200-mW Amplifier employing Transistors.—(*Mullard tech. Commun.*, April 1956, Vol. 2, No. 18, pp. 210–216.) The a.f. amplifier described comprises an input stage, a driver and a class-B stage, with overall feedback; the maximum output is 215 mW, measured at 400 c/s, with 10% total harmonic distortion, mainly third harmonic. The sensitivity at the 2·5-kΩ input terminal is about 6 mV. Minimum total distortion is 1·7%, at an output of about 15 mW.

621.376.332 **3325**

Design of a Simple Linear Frequency Discriminator.—K. G. Fancourt & J. K. Skwirzynski. (*Marconi Rev.*, 2nd Quarter 1956, Vol. 9, No. 121, pp. 61–77.) The discriminator described consists essentially of two tuned circuits with the parameters chosen to minimize second and third harmonics. Design information is presented in graphs.

GENERAL PHYSICS

534.01 : 519.2 **3326**

Statistical Properties of a Moving Waveform.—M. S. Longuet-Higgins. (*Proc. Camb. phil. Soc.*, April 1956, Vol. 52, Part 2, pp. 234–245.)

537/538].081 **3327**

The Giorgi System of Units and the Rationalization of the Equations of Electricity.—A. Iliovici. (*Rev. gén. Élect.*, April 1956, Vol. 65, No. 4, pp. 245–251.)

537.2 : 621.3.011.1 **3328**

New Theorems on the Electrostatic Field.—B. Konorski. (*Archiwum Elektrotech.*, 1955, Vol. 4, No. 1, pp. 65–157. German summary, pp. 155–157.) The 'law of least capacitance' is discussed; the concept of the 'intermediate electrode' is introduced to facilitate the formulation. A system of two cylinders with parallel axes is considered, and an examination is made of the variation of the total capacitance of the system on displacing the imaginary intermediate electrode constituted by an infinitely thin metal sheet shaped to coincide with one of the equipotential surfaces. The analysis is extended to systems of spheres and other geometrical forms. Formulae giving attractive and repulsive forces for numerous particular cases are tabulated.

537.29 : 537.56 : 621.385.833 **3329**

Field Ionization of Gases at a Metal Surface and the Resolution of the Field Ion Microscope.—E. W. Müller & K. Bahadur. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 624–631.)

537.29 : 539.233 : 621.385.833 **3330**

Field Desorption.—E. W. Müller. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 618–624.) Report of a study of the action of strong electric fields in removing adsorbed films of Ba, Th, etc., from a W surface, using a field-emission microscope and maintaining the metal surface positive.

537.311.1 **3331**

Electronic Conduction in Solids with Spherically Symmetric Band Structure.—R. Barrie. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 553–561.) Elastic scattering of electrons by ionized impurities, and inelastic scattering by the non-acoustical modes of the lattice vibrations in a homopolar crystal, are discussed for electrons whose energy is a nonquadratic function of the wave number vector.

537.311.1 **3332**

Acceleration of Electrons by an External Force Field.—E. N. Adams & P. N. Argyres. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 605–606.) "The usual proof that an electron in an energy band reacts to an external force as though it had an effective mass is shown to be invalid. It is shown, however, that for static externally applied fields, modified (field-dependent) energy bands can be found for which the acceleration theorem is rigorously correct."

537.311.62 : 537.312.62 **3333**

The Penetration Depth in Impure Superconducting Tin.—R. G. Chambers. (*Proc. Camb. phil. Soc.*, April 1956, Vol. 52, Part 2, pp. 363–375.) "A new method is described for measuring the surface impedance of metals at low temperatures and at radio-frequencies. Using this method, the surface impedance of normal tin and the penetration depth λ in superconducting tin have been studied at about 9 Mc/s frequency as a function of impurity content. The measured surface impedances agree well with the values expected, and the penetration depths increase with impurity content, in confirmation of Pippard's observations [*Proc. roy. Soc. A*, 24th Feb. 1953, Vol. 216, No. 1127, pp. 547–568] at 9·400 Mc/s."

537.311.62 : 538.569.4 **3334**

Cyclotron Resonance under Anomalous Skin-Effect Conditions.—R. G. Chambers. (*Phil. Mag.*, May 1956, Vol. 1, No. 5, pp. 459–465.) Results to be expected from attempts to observe cyclotron resonance in metals are discussed.

537.5 **3335**

Mobility and Space Charge of Ions in Nonuniform Field.—Yu. M. Kagan & V. I. Perel'. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1956, Vol. 108, No. 2, pp. 222–225. In Russian.) The equations developed lead to a generalization of the Child-Langmuir 3/2-power law to cover the case of arbitrary pressures.

537.5 **3336**

The Carrier Density in a Plasma and its Determination by means of the Pulse Probe.—D. Kamke & H. J. Rose. (*Z. Phys.*, 9th April 1956, Vol. 145, No. 1, pp. 83–115.) The pulse method discussed does not depend on particular assumptions regarding the transition layer between the unipolar (Langmuir) layer and the undisturbed plasma. Theory, apparatus and experimental results are described. Over 40 references.

537.52 **3337**

Statistical Study of Electron Avalanches in Gaseous Discharge.—S. Kojima & K. Kato. (*J. phys. Soc. Japan*, March 1956, Vol. 11, No. 3, pp. 322–326.) For low pressures the pulse size distribution at potentials below the breakdown value agreed with that given by the Townsend theory, assuming the absence of space charge. At atmospheric pressure the discharge was modified, probably by space charge, and pulse size tended to become uniform.

537.525 **3338**

Starting of an Electrical Gas Discharge in a Uniform Alternating Field.—W. Fucks, L. Graf, G. Mues & H. G. Müller. (*Z. Phys.*, 9th April 1956, Vol. 145, No. 1, pp. 1–19.) In the sub-critical range, i.e. when the

half-period of the alternating field is greater than the duration of an ionization step, the number of ionization steps in a half-period varies with frequency and with field strength. Over this range, the breakdown-voltage/frequency characteristic is positive, but beyond a certain value of frequency it becomes negative, later undergoing a further inflection, so that at a frequency of 2×10^8 c/s it is again positive. Comprehensive experimental results illustrating these phases and the influences of pressure and electrode separation on them are presented.

537.525.92 : 537.56 **3339**

'Contact' Phenomena in Plasma.—L. A. Sena & N. S. Taube. (*Zh. eksp. teor. Fiz.*, Feb. 1956, Vol. 30, No. 2, pp. 287–290.) Discontinuities of potential between parts of a plasma which differ in electron concentration and temperature are considered theoretically by the classical contact-potential theory of metals. The validity of this treatment is confirmed experimentaliy.

537.533 : 537.312.62 **3340**

Investigation of Electron Emission from Superconductors.—F. Bedard, H. Meissner & G. E. Owen. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 667–670.)

537.533 : 537.534.8 **3341**

Secondary Electron Emission from Metals under the Action of Ions and Neutral Particles.—V. G. Tel'kovski. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1956, Vol. 108, No. 3, pp. 444–446. In Russian.) Experimental results obtained by bombardment of clean metals with ions of H, He, N, Ne, Ar and Mo and neutral atoms of the inert gases show that the coefficient of secondary emission increases linearly at particle velocities up to 2×10^8 cm/s; for proton bombardment a maximum occurs at a velocity of $2{\cdot}5 \times 10^8$ cm/s.

537.533.7 **3342**

Investigation of Characteristic Energy Losses by the Retarding-Field Method.—G. Haberstroh. (*Z. Phys.*, 9th April 1956, Vol. 145, No. 1, pp. 20–43.) The energy distribution of electrons and the angular distribution of their paths after passage through thin foils of Al, Ag, Ge and Al_2O_3 are studied.

537.533.8 **3343**

Dependence of Secondary Electron Emission upon Angle of Incidence of 1·3-MeV Primaries.—R. A. Shatas, J. F. Marshall & M. A. Pomerantz. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 682–686.)

537.533.8 : 537.226 **3344**

Secondary Electron Emission from Dielectrics.—A. R. Shul'man. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2150–2156.) Experiments are described in which, in order to avoid changes in the structure of the target due to electron bombardment, the primary beam was switched on for only 10–30 μs, so that there was one incident electron for about 10^5 atoms of the emitter surface, and the destruction of the target could therefore be neglected. The results obtained are different from those usually quoted; a new interpretation of the phenomenon is given.

537.56 : 538.56 **3345**

Model for Collision Processes in Gases: Small-Amplitude Oscillations of Charged Two-Component Systems.—E. P. Gross & M. Krook. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 593–604.) Continuation of work reported previously [2633 of 1954 (Bhatnagar et al.)].

537.562 : 538.561 : 523.16 **3346**

Large-Amplitude Plasma Streaming and Charge Segregation.—R. W. Larenz. (*Z. Naturf.*, Sept./Oct. 1955, Vol. 10a, Nos. 9/10, pp. 766–776.) See 1015 of 1955; see also *ibid.*, pp. 761–765.

538.3·1 : 538.65 **3347**

The Magnetostatic Force on Two Circular Cylindrical Conductors carrying Uniform Steady Currents.—E. E. Jones. (*J. Franklin Inst.*, April 1956, Vol. 261, No. 4, pp. 397–408.) The magnetic field due to two parallel conductors in a nonuniform magnetic field is determined for the case when the conductor material is magnetic. General expressions are deduced for the magnetostatic force and are investigated for particular examples.

538.5 : 621.313 **3348**

Fluid Self-Excited Dynamo.—L. Davis, Jr. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 939–940.) "The possibility that a simply connected perfectly conducting fluid body could generate an increasing external magnetic field by acting as a self-excited dynamo is demonstrated by exhibiting a cycle of motions that doubles the external field each cycle. The essential feature of the motion is that interior points become surface points."

538.56 : 544.68 : 535.33 **3349**

Analysis of Traces of Impurities in Rare Gases by Ultra-high-Frequency Excitation of Optical Radiation.—M. Servigne, P. Guérin de Montgareuil & D. Dominé. (*C. R. Acad. Sci., Paris*, 11th June 1956, Vol. 242, No. 24, pp. 2827–2830.) Technique is discussed in which a ceil, filled at low pressure with the gas to be analysed, is arranged in the field of a continuous microwave oscillation generated by a magnetron.

538.561 : 537.533 **3350**

Čerenkov Radiation from Extended Electron Beams near a Medium of Complex Index of Refraction.—H. Lashinsky. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 631–635.) Extension of the theory presented by Danos (1628 of 1955). If ferrites are used in place of simple dielectric media, the radiated power can, under suitable conditions, be increased.

538.566 : 537.562 **3351**

Variation with Electron Energy of the Collision Cross-Section of Helium for Slow Electrons.—J. M. Anderson & L. Goldstein. (*Phys., Rev.* 15th May 1956, Vol. 102, No. 4, pp. 933–938.) Continuation of previous work on the interaction of microwaves in gas-discharge plasmas (1383 of May and back references). Momentum transfer between He atoms and electrons with energies between 0·04 and 0·4 eV is investigated, the electron density being not less than about 10^{10}/cm^3. Experimental results appear to indicate a slight variation of momentum transfer with electron energy.

538.6 **3352**

Motion of a Sphere through a Conducting Fluid in the Presence of a Strong Magnetic Field.—K. Stewartson. (*Proc. Camb. phil. Soc.*, April 1956, Vol. 52, Part 2, pp. 301–316.)

537.5 **3353**

Basic Processes of Gaseous Electronics. [Book Review]—L. B. Loeb. Publishers: University of California Press, Berkeley and Los Angeles; Cambridge University Press, London, 1955, 1012 pp., 100s. (*Brit. Commun. Electronics*, April 1956, Vol. 3, No. 4, p. 214.) A comprehensive review.

538.566 : 535.4 **3354**

Scattering and Diffraction of Radio Waves. [Book Review]—J. R. Mentzer. Publishers: Pergamon Press, London and New York, 142 pp., 30s. (*J. Instn elect. Engrs*, May 1955, Vol. 2, No. 17, p. 301.) One of a series of monographs on *Electronics and Waves*; mathematical methods are indicated for solving problems encountered in the study of radar performance and aerial systems.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523 : 538.3 : 550.38 **3355**

Hydromagnetic Dynamo Theory.—W. M. Elsasser. (*Rev. mod. Phys.*, April 1956, Vol. 28, No. 2, pp. 135–163.) The equations of magnetohydrodynamics are used to study the mechanism whereby cosmic magnetic fields such as those of the earth, of sunspots and the sun, and of magnetic stars are generated and maintained.

523.16 **3356**

The Nature of Radiation from Radiogalaxy NGC 4486.—I. S. Shklovski. (*Astronom. Zh.*, May/June 1955, Vol. 32, No. 3, pp. 215–225. English summary.) The continuous optical radiation from the 'jet' in the core of the galaxy is explained quantitatively by the presence of relativistic electrons with energies of 10^{11}–10^{12} eV moving in a magnetic field of approximately 10^{-4} G; relativistic electrons with energies of 10^8–10^9 eV diffusing into the galaxy are probably the source of r.f. emission.

523.16 : 523.42 **3357**

Impulsive Radio Signals from the Planet Venus.—J. D. Kraus. (*Nature, Lond.*, 7th July 1956, Vol. 178, No. 4523, p. 33.) Report of reception at the Ohio State University of radiation at a wavelength of 11 m. The observations were made using an interferometer array of horizontal $\lambda/2$ elements with reflectors. The peak power in a burst is estimated to be about 40 W per c/s of bandwidth; this is about 0·003 of the value estimated for a burst from Jupiter. On the basis of power considerations, the mechanism involved could be of lightning-discharge type. A record obtained on 30th May 1956 is reproduced and discussed *ibid.*, 14th July 1956, Vol. 178, No. 4524, pp. 103–104.

523.16 : 523.42 **3358**

Class II Radio Signals from Venus at a Wavelength of 11 Metres.—J. D. Kraus. (*Nature, Lond.*, 21st July 1956, Vol. 178, No. 4525, pp. 159–160.) Reception of radiation with a different waveform from that discussed previously (3357 above) is reported; this radiation, designated class II, is of a more sustained nature, lasting for a second or longer and varying at an a.f. rate, e.g. 125 c/s. A record of a series of pulses observed on 4th June 1956 is shown. The radiation appears to have a bandwidth of at least 2 Mc/s. On studying tape recordings, signals resembling echoes were noted; these may be due to reflection from the moon.

523.16 : 537.562 : 538.561 **3359**

Large-Amplitude Plasma Streaming and Charge Segregation.—Larenz. (See 3346.)

523.16 : 551.510.535 : 621.396.11 **3360**

On the Propagation of Radio Waves through the Upper Ionosphere.—Ellis. (See 3514.)

523.16 + 523.5 + 551.594.5] : 551.510.535: 621.396.11.029.6 **3361**

Review of Ionospheric Effects at V.H.F. and U.H.F.—Little, Rayton & Roof. (See 3519.)

523.5 : 537.56 **3362**

Inadequacy of Recombination as the Source of Light from Enduring Meteor Trains.—G. S. Hawkins & A. F. Cook. (*Nature, Lond.*, 21st July 1956, Vol. 178, No. 4525, pp. 161–162.) Critical discussion of the suggestion made by Opik (3592 of 1955) that the column of light produced by a meteor is due to recombination of the meteoric ions and free electrons.

523.72 : 523.78 **3363**

Observations of Solar Radio Radiation during the Eclipse of June 30th, 1954: Part 1.—O. Czyżewski, J. de Mezer & A. Strzalkowski. (*Acta geophys. polon.*, 1955, Vol. 3, No. 4, pp. 155–160. In English.) Observations made at Cracow, using apparatus operating at about 1 m λ with a parabolic aerial of diameter 5 m, are reported. Records for July 12th and 13th are shown for comparison with those for the eclipse day.

550.385 : 523.7 **3364**

A Note on the Annual Variation of Geomagnetic Activity and M-Regions.—J. N. Tandon. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 211–213.) "Results of an investigation are given associating recurrent 27-day geomagnetic activity with M-regions of the sun, around years of sunspot minima. The association of M-sequences with various solar features of the disk and corona is also indicated." For a longer account of related work, see *Indian J. Phys.*, April 1956, Vol. 30, No. 4, pp. 153–168.

551.51 **3365**

Charge Transfer in the Upper Atmosphere.—S. N. Ghosh. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 193–200.) Collision processes involving charged solar particles entering the upper atmosphere are discussed. Charge-transfer reactions involving solar H^+ and Ca^+ ions are likely to excite spectrum lines of these elements and of the atmospheric gases; in the case of H^+, at auroral levels. The ratio of the density of O^+ to O_2^+ ions and the effective recombination coefficient for the F layer are derived.

551.510.3 **3366**

On a Pitot-Tube Method of Upper-Atmosphere Measurements.—Vi-Cheng Liu. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 171–178.) A method is presented for deducing atmospheric density, pressure and temperature at heights up to 80 km.

551.510.3 : 535.325 **3367**

Thermodynamic Method for Measurement of the Refractive Index of the Atmosphere. Description of the Radiosonde MD1.—P. Misme. (*Ann. Télécommun.*, April 1956, Vol. 11, No. 4, pp. 81–84.) Apparatus is described which is capable of determining the distribution of temperature, pressure and humidity variations with a fineness sufficient for radio-propagation calculations.

551.510.5 : 551.593.9 **3368**

The Altitude of the (OI) 5577A Line in the Night Airglow measured from a Rocket.—O. E. Berg, M. Koomen, L. Meredith & R. Scolnik. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 302–303.) Measurements using rocket-borne photometers show that the layer from which the λ 5577 line originates lies between 70 and 105 km, with peak luminosity between 90 and 95 km.

551.510.5 : 551.593.9 **3369**

Distribution of the Night Airglow (OI) 5577A and Na D [-line] Layers measured from a Rocket.—M. Koomen, R. Scolnik & R. Tousey. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 304–306.) An

experiment similar to that described by Berg et al. (3368 above) confirms the results for the λ 5577 line and shows that the sodium D lines are excited in a layer of altitude between 70 and 95 km.

551.510.52 **3370**

Determination of the Alpha-Ray Emission of Materials constituting the Earth's Surface.—V. F. Hess, V. J. Kisselbach & H. A. Miranda, Jr. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 265–271.) It is concluded, from measurements, that α-ray emission is not an important factor in the ionization balance of the lower atmosphere.

551.510.535 + 523 **3371**

Influence of Magnetic Field on Convective Instability in the Atmospheres of Stars and in the Ionosphere of the Earth.—B. N. Gershman & V. L. Ginzburg. (*Astronom. Zh.*, May/June 1955, Vol. 32, No. 3, pp. 201–208.) The case of a medium with anisotropic electrical and thermal conductivities is considered. In a plasma which does not contain a large number of neutral particles the calculated influence of the magnetic field on convection is essentially different from that predicted by the magnetohydrodynamic approximation; in the ionosphere the influence of the magnetic field is small owing to the presence of a large number of molecules. See also 2290 of 1955.

551.510.535 **3372**

Electron Resonance in Ionospheric Waves.—C. O. Hines. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 56–70.) Certain features of large-scale travelling disturbances in the F layer are explained as electron-resonance effects, whereby small initial disturbances are amplified. Estimates of ionospheric parameters based on this interpretation are in good agreement with values to be expected.

551.510.535 **3373**

Two Types of Development of the E_2 Layer at Ahmedabad.—R. G. Rastogi. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 71–72 and plates.) The sequence of phenomena leading to the separation of E_2 and E_1 layers after high-level sunrise is summarized and illustrated by photographic records. The existence of a layer which is photo-ionized by solar radiation at a height of about 150 km is indicated.

551.510.535 **3374**

World-Wide Spread F.—G. Reber. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 157–164.) Records from widely distributed ionosphere stations for the period of the last complete sunspot cycle show that the spread-F equator is roughly parallel to the geomagnetic equator, swinging $\pm 25°$ of latitude over the cycle.

551.510.535 : 523.72 **3375**

The Solar X-Ray Spectrum and the Density of the Upper Atmosphere.—E. T. Byram, T. A. Chubb & H. Friedman. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 251–263.) Data derived from rocket experiments give a measure of the flux density of solar X rays incident on the E layer. From the rate of X-ray absorption at heights between 128 and 110 km the atmospheric density is computed to be about one-third of the current Rocket Panel average values.

551.510.535 + 550.385] : 523.75 **3376**

Ionospheric Effects produced by Solar Flare Radiation.—V. Agy. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, p. 917.) Comment on 423 of February (Sedra & Hazzaa).

551.510.535 : 523.78 **3377**

The Effective Recombination Coefficients in the E and F_1 Layers during the Solar Eclipse of 25 February 1952.—C. M. Minnis. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 36–44.) The contribution to the E-layer ionization of each of two isolated sources of radiation assumed to exist near the east and west limbs of the sun is derived and expressed as a linear function of $1/\alpha'$, where α' is the effective recombination coefficient during the eclipse. On equating the corresponding functions for Khartoum and Ibadan it is found that for both places $\alpha'_E = 1{\cdot}2 \times 10^{-8}\,cm^3\,s^{-1}$ as against the value $1{\cdot}5 \times 10^{-8}\,cm^3\,s^{-1}$ obtained for Khartoum on assuming that the intensity of ionizing radiation fell to zero at second contact (2298 of 1955). For the F_1 layer it is concluded that $\alpha'_{F_1} = 0{\cdot}65 \times 10^{-8}\,cm^3\,s^{-1}$.

551.510.535 : 523.78 **3378**

Interpretation of Ionospheric Measurements made during Solar Eclipses.—C. M. Minnis. (*Nature, Lond.*, 7th July 1956, Vol. 178, No. 4523, pp. 33–34.) By combining observational data obtained at Khartoum and Ibadan during the eclipse of 1952, a determination is made of the recombination coefficient in the E layer; the most probable value is 1·2. This result is at variance with the conclusions reached by Hunaerts & Nicolet (1412 of May), and implies absence of radiation from the corona. See also 3377 above.

551.510.535 : 523.78 **3379**

Ionospheric Observations during the Solar Eclipse of 30th June 1954.—B. Landmark, F. Lied, T. Orhaug & S. Skribeland. (*Geofys. Publ.*, 1956, Vol. 19, No. 8, pp. 1–39.) Records of *h'f* were obtained in Norway at Tromøya (100% obscuration), Kjeller (96%) and Tromsø (66%). Strong E_s ionization prevented the accurate observation of f_0E, but f_0F_1 was reliable and, assuming complete cut-off of the ionizing radiation at totality, gave $\alpha_E = 1{\cdot}7 \times 10^{-8}\,cm^3\,s^{-1}$ at Tromøya. The F_1-layer data are consistent with a solar model in which 14% and 5% of the radiation was emitted from areas near the west and east limbs respectively; 10% originated in an undefined area which may cover the greater part of the sun's disk. The changes in f_0F_2 indicate a marked solar control of the F_2 layer and, assuming a recombination law, give $\alpha_{F_2} \simeq 3 \times 10^{-9}\,cm^3\,s^{-1}$. Measurements of D-region absorption are consistent with the solar model deduced from the F_1-layer data, and give $\alpha_D/N_0 = 13 \times 10^{-4}\,s^{-1}$. A theoretical treatment is given of the eclipse changes in the D region.

551.510.535 : 550.385 **3380**

Systematic Investigations of the Influence of Geomagnetic Activity on the Nocturnal Critical Frequencies of the F_2 Layer.—G. Lange-Hesse. (*Arch. elekt. Übertragung*, April 1956, Vol. 10, No. 4, pp. 139–144.) Results of a statistical analysis of data covering a period of 6¼ years are presented graphically. The probability that a geomagnetic activity index C_k, of magnitude $1{\cdot}2 \leqslant C_k \leqslant 2{\cdot}0$ determined over a 24-hour period 1800–1800, is followed by an ionospheric storm is 80% in the summer of a sunspot-maximum year and 60% in winter; the corresponding figures for a 0600–0600 C_k index in a sunspot-minimum year are 75% and 55% respectively. See also 2942 of 1954.

551.510.535 : 621.396.11 **3381**

Ionospheric Absorption at Dakar.—Delobeau & Suchy. (See 3513.)

551.510.535 : 621.396.11 **3382**

Calculation of Charge Density Distribution of Multilayers from Transit-Time Data.—J. Shmoys & S. N. Karp. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 183–191.) A method is discussed for calculating the electron-density distribution in the ionosphere from data obtained using a rocket-borne variable-frequency transmitter, or pulse reflections from higher layers. It is not possible to obtain a solution free from ambiguity.

551.594.5 **3383**

Characteristics of Auroras caused by Angular Dispersed Protons.—A. Omholt. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 18–27.)

551.594.5 : 551.510.535 **3384**

Secondary Processes due to Absorption of the Lyman Lines emitted from Aurorae.—A. Omholt. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 28–35.) Discussion indicates that the α line of the hydrogen Lyman series emitted from aurorae may be effective in ionizing NO in the lower atmosphere, but not to the extent required for polar blackouts. Absorption of the Lyman β line by oxygen atoms is not significant in ordinary aurorae.

551.594.6 **3385**

On the Waveform of a Radio Atmospheric at Short Ranges.—J. R. Wait. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, p. 1052.) Calculated values for the waveform at various distances up to 200 km from the discharge are shown graphically; the ionospherically reflected wave is not taken into account, and the discharge producing the atmospheric is represented by an idealized function.

LOCATION AND AIDS TO NAVIGATION

621.396.933 : 621.396.676 **3386**

TACAN Radio Bearing and Distance System for Aerial Navigation.—(*Elect. Commun.*, March 1956, Vol. 33, No. 1, pp. 2–100.) A symposium comprising the following papers:—

Development of Tacan at Federal Telecommunication Laboratories.—P. C. Sandretto (pp. 4–10).

Principles of Tacan.—R. I. Colin & S. H. Dodington (pp. 11–25).

Tacan Ground Beacon AN/URN-3.—H. B. Scarborough (pp. 26–34).

Antenna for the AN/URN-3 Tacan Beacon.—A. M. Casabona (pp. 35–59).

Airborne Tacan Equipment AN/ARN-21.—S. H. Dodington (pp. 60–64).

British Tacan Equipment (pp. 65–66).

Experimental Determination of Tacan Bearing and Distance Accuracy.—E. DeFaymoreau (pp. 67–73).

Coordinated-System Concept of Air Navigation.—P. C. Sandretto (pp. 74–79).

Quartz-Crystal Control at 1 000 Mc/s.—S. H. Dodington (pp. 80–84).

Error Reduction in Tacan Bearing-Indication Facility.—M. Masonson (pp. 85–100).

For a short description of Tacan, see 125 of January.

621.396.962.3 **3387**

Marconi Coherent M.T.I. Radar on 50 cm.—E. Eastwood, T. R. Blakemore & B. J. Witt. (*Marconi Rev.*, 2nd Quarter 1956, Vol. 19, No. 121, pp. 53–60.) The Type-S.232 equipment for airport terminal work is described. The pulse length is 2 or 4 μs, and the repetition rate 500–800/s.

621.396.962.38 **3388**

Some Problems of Secondary Surveillance Radar Systems.—K. E. Harris. (*J. Brit. Instn Radio Engrs*, July 1956, Vol. 16, No. 7, pp. 355–382.) Systems comprising a ground interrogator and airborne transponders, for air traffic control, are discussed. The choice of operating frequency is governed by international allocations, availability of components, and required horizontal definition. Systems are classified as dependent or independent according as they do or do not use the primary radar transmitter as interrogator. The scanning and display arrangements may also be either associated or dissociated. Side-lobe effects can be eliminated by either responsor or interrogator suppression. Other problems considered include transponder saturation and methods of count-down, the 'capture' of airborne units by one ground station to the exclusion of others, second-time-round signals, unlocked responses due to remote ground stations, and coding.

621.396.969.3 **3389**

Automatic Tracking Radar Systems.—P. Bouvier. (*Onde élect.*, April 1956, Vol. 36, No. 349, pp. 336–347.) The operating principles of the system are explained and French equipment in large-scale production is briefly described; the wavelength used is 10 cm.

621.396.969.3 **3390**

Some Limiting Cases of Radar Sea Clutter Noise.—A. H. Schooley. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1043–1047.) Analysis is presented yielding limiting values of the effective radar scattering area per unit area of the sea surface, as a function of the radar depression angle, for perfectly smooth and for rough surfaces. Some experimental data supporting the theory are also presented.

MATERIALS AND SUBSIDIARY TECHNIQUES

531.788.7 **3391**

Absolute Determination of Pressure using the Ionization Gauge.—R. P. Henry. (*Le Vide*, March/April 1956, Vol. 11, No. 62, pp. 54–63.)

533.5 : 546.49 **3392**

Technology and Application of Mercury in Vacuum Technique.—W. Espe. (*NachrTech.*, April 1956, Vol. 6, No. 4, pp. 155–161.) A survey with 59 references.

533.56 **3393**

Diffusion Pump using Freon 12.—J. Delcher, R. Geller, G. Mongodin & F. Prévot. (*Le Vide*, March/April 1956, Vol. 11, No. 62, pp. 78–80.)

535.215 **3394**

Infrared Response of Pyrolyzed Organic Films.—J. F. Andrew. (*J. opt. Soc. Amer.*, March 1956, Vol. 46, No. 3, pp. 209–214.) Report of an experimental investigation of photoconduction in films prepared by pyrolysis of cellophane and orlon.

535.215 : 538.569 **3395**

Study of Crystallized P_2Zn_3 at Low Temperatures.—J. Lagrenaudie. (*J. Phys. Radium*, April 1956, Vol. 17, No. 4, pp. 359–362.) An experimental investigation of photoconduction and photomagnetoelectric effect in this material is reported. The existence of traps at several levels is demonstrated. The results are compared with those for Te.

535.215 : 546.811-3 **3396**

Relaxation of Photoconductivity of Stannic Oxide.—A. I. Andrievski & V. A. Zhuravlev. (*C. R. Acad. Sci. U.R.S.S.*, 1st May 1956, Vol. 108, No. 1, pp. 43–46. In Russian.) Relaxation times of 20–3 000 s were observed in different specimens; each specimen possessed several relaxation times, the magnitudes and numbers of which varied with the intensity of illumination. These results are discussed.

535.37 **3397**

Contribution to the Problem of Nonstoichiometry in Oxygen-Dominated Phosphors.—J. L. Ouweltjes & W. L. Wanmaker. (*J. electrochem. Soc.*, March 1956, Vol. 103, No. 3, pp. 160–165.)

535.376 **3398**

Field-Induced Color Shift in Electroluminescent Zinc Sulfide.—J. F. Waymouth & F. Bitter. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 686–689.)

537.226/.228.1 : 546.431.824-31 **3399**

Preparation of Barium Titanyl Oxalate Tetrahydrate for Conversion to Barium Titanate of High Purity.—W. S. Clabaugh, E. M. Swiggard & R. Gilchrist. (*J. Res. nat. Bur. Stand.*, May 1956, Vol. 56, No. 5, pp. 289–291.)

537.226/.228.1 : 546.431.824-31 **3400**

Anomalous Polarization in Undiluted Ceramic $BaTiO_3$.—H. L. Blood, S. Levine & N. H. Roberts. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 660–661.) Experimental results are presented and briefly discussed; observed deviations from normal ferroelectric behaviour may be related to those discussed by Känzig (e.g. 2988 of 1955).

537.226/.227 **3401**

Structure and Phase Transitions of Ferroelectric Sodium-Cadmium Niobates.—B. Lewis & E. A. D. White. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 646–664.) Report of a detailed experimental investigation. Sodium-cadmium niobates form single-phase solid solutions of perovskite type, the cadmium niobate entering as $CdNb_2O_6$ rather than $Cd_2Nb_2O_7$. The ferroelectric properties are associated with a doubled unit cell, whereas antiferroelectric sodium niobate has a quadrupled cell. Over a range of composition and temperature the ferroelectric and antiferroelectric structures coexist. See also 2087 of July.

537.226/.227 **3402**

High Permittivity of Niobates and Tantalates of Divalent Metals.—G. A. Smolenski, V. A. Isupov & A. I. Agranovskaya. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1956, Vol. 108, No. 2, pp. 232–235. In Russian.) The dielectric constant at 1 kc/s and its temperature coefficient, and the loss tangent at 1 kc/s and temperature 20°C are tabulated for niobates, metaniobates, tantalates and metatantalates of Ca, Cd, Sr, Pb and Ba. The curves presented show that $Sr_2Ta_2O_7$ is ferroelectric; the maxima of the ϵ and tan δ temperature curves for $CdNb_2O_6$ are due not to a ferroelectric phase transition but to electronic processes.

537.227 **3403**

Spontaneous Polarization of Guanidine Aluminum Sulfate Hexahydrate at Low Temperatures.—A. G. Chynoweth. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1021–1023.) The spontaneous polarization of this material [2415 of August (Holden et al.)] was investigated by observing the pyroelectric effect, using the method described in 1745 of June. The results indicate that the spontaneous polarization and the specific heat are smooth functions of temperature over the range from room temperature down to −180°C; there is no evidence of a phase transition or Curie point.

537.227 **3404**

Ferroelectricity in the Alums.—R. Pepinsky, F. Jona & G. Shirane. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1181–1182.) Measurements on a large number of alums indicate that some are ferroelectric, others antiferroelectric. The dielectric-constant/temperature curve and hysteresis loops are presented for methylammonium aluminium sulphate dodecahydrate (MASD), which is typical of the ferroelectric alums.

537.227 **3405**

Ferroelectric Properties of Solid Solutions of $(Pb,Ba)SnO_3$, $Pb(Ti,Sn)O_3$ and $Pb(Zr,Sn)O_3$.—G. A. Smolenski, A. I. Agranovskaya, A. M. Kalinina & T. M. Fedotova. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2134–2142.) A report is presented on an experimental investigation. The main conclusions reached are: (*a*) solid solutions of $(Ba,Pb)SnO_3$ possess ferroelectric properties; as distinct from other ferroelectrics, their central ions do not possess the electron structure of the atom of a noble gas; (*b*) the transition temperature of these solid solutions is displaced towards lower temperatures as the $BaSnO_3$ content increases; (*c*) solid solutions of $Pb(Ti,Sn)O_3$ and $Pb(Zr,Sn)O_3$ are characterized by high transition temperatures even for a high content of $PbSnO_3$; (*d*) two phase transitions are observed in solid solutions of $Pb(Zr,Sn)O_3$.

537.227 : 546.431.824-31 **3406**

Surface Space-Charge Layers in Barium Titanate.—A. G. Chynoweth. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 705–714.) Effects of the type discussed by Känzig (2988 of 1955) are investigated experimentally using technique described previously (1745 of June). From the waveforms of the pyroelectric current signals, it is tentatively concluded that space-charge layers up to 10^{-5} cm thick exist at the surface of single crystals, and that these space charges also produce a field through the bulk of the crystal. Corroboratory evidence is provided by an associated photovoltaic effect and asymmetry of the hysteresis loops. Various effects due to these space-charge fields are mentioned.

537.228.1 : 546.431.824-31 **3407**

Dielectric and Piezoelectric Properties of the Solid Solutions $(Ba,Sr)TiO_3$, $(Ba,Pb)TiO_3$, $Ba(Ti,Sn)O_3$ and $Ba(Ti,Zr)O_3$.—N. A. Roi. (*Akust. Zh.*, Jan.–March 1956, Vol. 2, No. 1, pp. 62–70.) Measurements are presented graphically of the following characteristics: (*a*) ϵ/T, (*b*) d_{33}/E_0, (*c*) coercive-force/composition, where ϵ is the permittivity, T the temperature, d_{33} the piezoelectric modulus and E_0 the polarizing field strength.

537.311.31 : 538.63 : 546.47 **3408**

The Interrelation of the Anisotropy of the Hall Effect and the Change of Resistance in Metals in a Magnetic Field: Part 1—Investigation of Zinc.—E. S. Borovik. (*Zh. eksp. teor. Fiz.*, Feb. 1956, Vol. 30, No. 2, pp. 262–271. English summary, *ibid.*, Supplement, p. 4.)

537.311.33 + 621.315.6 **3409**

Ionization Interaction between Impurities in Semiconductors and Insulators.—R. L. Longini & R. F. Greene. (*Phys. Rev.*, 15th May 1956, Vol. 102,

No. 4, pp. 992–999.) The free energy of an imperfect crystal includes components which arise from the ionizability of these imperfections and which represent chemical interactions between them. These ionization terms, which involve the Fermi level and the parameters of the energy-band model, are used to explain systematic differences between *n*- and *p*-type semiconductors in respect of lattice-vacancy concentration, substitutional-atom diffusion coefficients and amphoteric-impurity behaviour, as well as the variation of solid/liquid impurity distribution coefficients of some semiconductors with the rate of crystal growth, and the 'charge-balance' effect in insulators.

537.311.33 **3410**

Surface Barriers at Semiconductor Contacts.—R. Stratton. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 513–527.) Current flow across a surface of discontinuity is treated according to the diode and the diffusion theories of barrier rectifiers and the results are applied to measurements on SiC point contacts and a grain boundary in Ge, respectively. The contact resistance found is consistent with a barrier caused by donor and acceptor surface states, whose density on SiC is about $10^{13}/cm^2$ and on Ge about $5 \times 10^{11}/cm^2$.

537.311.33 **3411**

High-Frequency Conductivity in Semiconductors.—B. Donovan & N. H. March. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 528–538.) Theory is developed for nondegenerate semiconductors with spherical energy surfaces, the cases of single- and two-band models with lattice and impurity scattering being considered. Divergencies from available experimental results are discussed.

537.311.33 **3412**

The Stoichiometry of Intermetallic Semiconductors.—R. J. Hodgkinson. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 612–624.) The effects of small concentrations of point defects on the free energy of a crystal of formula AB are discussed. The maximum melting point of the compound does not occur at the composition corresponding exactly to the formula AB. The type of phase diagram arising from this fact is derived. Published experimental evidence is quoted in support of the theory. A crystal which is heat-treated in presence of its vapour will not necessarily have the same concentration of defects as one of the same composition grown from the melt at the same temperature.

537.311.33 **3413**

Negative Magnetoresistance Effect in Semiconductors.—C. Rigaux & J. M. Thuillier. (*C. R. Acad. Sci., Paris*, 4th June 1956, Vol. 242, No. 23, pp. 2710–2712.) An interpretation of the effect different from that of Mackintosh (2805 of September) or Stevens (2806 of September) is presented.

537.311.33 **3414**

Characteristic Times of Electronic Processes in Semiconductors.—E. I. Adirovich & G. M. Guro. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1956, Vol. 108, No. 3, pp. 417–420. In Russian.) Characteristic times are calculated, assuming the presence of recombination centres (traps) of one type and of fully ionized acceptors and donors. Two of the calculated characteristic times correspond to the electron and hole lifetimes calculated by Shockley & Read (420 of 1953), two others are decay times.

537.311.33 **3415**

Some Problems of the Multi-electron Theory of Semiconductors.—S. V. Vonsovski. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2022–2029.) The various stages in the development of the multi-electron theory are briefly reviewed and its advantages pointed out. The limitations of the theory are then considered, arising from (*a*) the use of the 'adiabatic' approximation in which there is no allowance for the active dynamic participation of the system of ions, and (*b*) the exaggerated importance attached to the ordered disposition of ions. The possibilities of overcoming these limitations are indicated and a generalized multi-electron model of atomic semiconductors is discussed.

537.311.33 **3416**

Theory of Semiconductors with an Impurity Band.—A. G. Samoilovich & M. I. Klinger. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2050–2060.) The properties of an electron gas are considered for the following two cases: (*a*) a metal with a narrow conduction band, and (*b*) a semiconductor with an impurity band. The chemical potential is calculated for both cases and the electrical conductivity and thermo-e.m.f. are also determined, in the first case from the degree of filling of the narrow band, and in the second case from the temperture. The results are compared with experimental data.

537.311.33 **3417**

Properties and Structure of Ternary Semiconducting Systems: Part 2—Electrical Properties and Structure of Materials of the System comprising Thallium, Antimony and Arsenic Selenides.—N. A. Goryunova & B. T. Kolomiets. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2069–2078.) In continuation of work reported previously [1751 of June (Kolomiets & Goryunova)] an investigation was made of the variation of the properties of intermediate mixtures at the transition between the crystalline and amorphous compounds. Seven melts with gradual replacement of Sb by As were synthesized and numerous experiments carried out.

537.311.33 **3418**

Correlation between the Heat of Formation of a Semiconductor and the Electron Mobility.—V. P. Zhuze. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2079–2092.) The insufficiency of the existing theory of electron mobility is pointed out; it would be of interest to determine experimentally the dependence of mobility on some macroscopic parameter of the substance. Reference is made to a previous investigation by Blum & Regel' (*ibid.*, March 1951, Vol. 21, pp. 316–327), where fairly close correlation was established between electron mobility and the heat of formation of binary semiconducting compounds. Much new information has since been accumulated; this is summarized in a table giving data on 39 compounds. The various factors underlying the observed correlation are discussed.

537.311.33 **3419**

The Temperature Dependence of the Density and Electrical Conductivity of Liquid Solutions of the System Te-Se.—N. P. Mokrovski & A. R. Regel'. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2093–2096.)

537.311.33 : 537.226 **3420**

The Present State of some Problems of the Theory of Semiconductors and Dielectrics, and Directions of Further Development of the Theory.—S. I. Pekar. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2030–2043.) Shortened version of a paper read at a conference on semiconductors held in Leningrad in February 1955. The headings are: (*a*) phenomenological theory of semiconductors; (*b*) kinetics of electrons in the conduction band; (*c*) thermal (radiationless) electron transitions; (*d*) photo-transitions of electrons; (*e*) methods of calculating the quantum stationary states of a crystal.

537.311.33 : 538.569.4 **3421**

Quantum Theory of Cyclotron Resonance in Semiconductors: General Theory.—J. M. Luttinger. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1030–1041.)

537.311.33 : 541.57 **3422**

The Chemical Bond in Semiconductors.—E. Mooser & W. B. Pearson. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 621–645.) Discussion presented previously (2781 of September) is treated more fully.

537.311.33 : 546.23 **3423**

The Absorption Edge of Amorphous Selenium and its Change with Temperature.—C. Hilsum. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 506–512.) Experimental results showing the variation of absorption coefficient with λ over the range 0·58–0·66 μ are presented. The absorption edge shifts with temperature by 2·7 Å/deg, equivalent to a change in the energy gap of $9{\cdot}7 \times 10^{-4}$ eV/deg.

537.311.33 : 546.26-1 : 539.1 **3424**

Effect of Fast Neutron Bombardment on Physical Properties of Graphite: a Review of Early Work at the Metallurgical Laboratory.—M. Burton & T. J. Neubert. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 557–567.) Variations of the elastic modulus and the thermal and electrical resistance are related to the displacement of the carbon atoms from their normal positions in the crystal lattice. Hall-effect measurements indicate that the neutron-induced disturbances are electron traps. Abstracts of papers by various workers dealing with the particular aspects are presented on pp. 568–572, following the main paper.

537.311.33 : 546.28 **3425**

Paramagnetic Resonance in As-Doped Silicon.—A. Honig & J. Combrisson. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 917–918.) As a result of studies further to those described previously [753 of 1955 (Honig)] a new interpretation of the observed effects is advanced.

537.311.33 : 546.28 + 549.514.5] : 539.2 **3426**

Adsorption of Ammonia on Silicon.—L. Miller. (*Z. Naturf.*, Sept./Oct. 1955, Vol. 10a, Nos. 9/10, pp. 801–802.) It has been found that the adsorption of NH_3 is a useful criterion in the investigation of the surface properties of quartz and other forms of SiO_2. The presence of water on a quartz surface is known to increase the adsorption of NH_3. Methods based on these effects are used to indicate the presence of SiO_2 layers on Si. Attempts to produce an oxide-free Si surface by h.f. technique were unsuccessful.

537.311.33 : 546.289 **3427**

A Note on the Theory of Dislocation in Germanium.—T. Shindo. (*J. phys. Soc. Japan*, March 1956, Vol. 11, No. 3, pp. 331–332.) Following on the work of Read (457 of 1955), a more general expression is found for the fraction of dislocation acceptor sites occupied, which reduces to that given by Read for the case when the number of trapped electrons is small compared with the number of donor centres.

537.311.33 : 546.289 **3428**

The Electrical Properties of Dislocations in Germanium.—J. W. Allen. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 580–588.) Different experimental results can be reduced to consistency by considering the effects of impurity-atmosphere formation at the dislocations. Experiments to test this theory are suggested.

537.311.33 : 546.289 **3429**

Self-Diffusion in Germanium.—H. Letaw, Jr, W. M. Portnoy & L. Slifkin. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 636–639.) "An accurate determination of the self-diffusion coefficient in germanium has been obtained. In the temperature range 766°–928°C, it is represented by $D = 7{\cdot}8 \exp(-68\,500/RT)$ cm² sec. The probable errors in the frequency factor and activation energy are $\pm$ 3·4 cm²/sec and $\pm$ 0·96 kcal/mol, respectively."

537.311.33 : 546.289 **3430**

Scattering of Carriers from Doubly Charged Impurity Sites in Germanium.—W. W. Tyler & H. H. Woodbury. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 647–655.) Measurements are reported which indicate that Zn is a double-acceptor impurity in Ge, the acceptor levels lying 0·03 and 0·09 eV from the valence band. Hall-effect measurements show that scattering from doubly charged Zn sites is about four times that from singly charged Ga sites. Photoconductivity measurements on *n*-type Ge specimens containing Fe or Mn impurities indicate that at high levels of illumination the steady-state increase in free-electron concentration is roughly equal to the known concentrations of double-acceptor impurities. The accompanying mobility increases provide additional confirmation of the assumption that holes trapped at doubly charged impurity sites are responsible for the photosensitivity.

537.311.33 : 546.289 **3431**

Measurements of Surface Electrical Properties of Bombardment-Cleaned Germanium.—J. T. Law & C. G. B. Garrett. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, p. 656.) Measurements were made of the surface recombination velocity and surface conductivity of a *p*-type bombardment-cleaned Ge specimen (*a*) in vacuum, (*b*) after admission of oxygen, and (*c*) after subsequent heating at about 400°C. The effects of step (*b*) are annulled by step (*c*). This result is interpreted as indicating that a bombardment-cleaned surface has already at least one layer of oxygen on it before any measurements can be made.

537.311.33 : 546.289 **3432**

Trap Activation Energies in *N*-Type Germanium.—P. Ransom & F. W. G. Rose. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 625–628.) Discussion indicates that it should be possible to determine from measurements by the Morton-Haynes method [741 of 1953 (Valdes)], in darkness and with various intensities of background illumination, both the activation energy and the concentration of different traps in a single sample.

537.311.33 : 546.289 **3433**

Observations on the Growth of Excess Current in Germanium *p-n* Junctions.—A. R. F. Hummer. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 539–547.) The excess current induced by water vapour has been resolved experimentally into two components having linear and saturation relations with the applied voltage; the possibility of identifying these components with channel and surface leakage currents is discussed but not established.

537.311.33 : 546.289 **3434**

The Possibility of obtaining a *p-n* Junction in Germanium by Pulse Heating.—M. M. Bredov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2104–2111.) The method proposed is based on the known fact that if *n*-type Ge is heated to a temperature of 800°–900° and then rapidly cooled, the sign of its conduction changes

(thermal conversion). If a short pulse of heat is applied to the specimen, conversion should take place in the surface layer and a p-n junction should be formed at a depth corresponding to the transition between the converted layer and the unaffected bulk of the specimen. The necessary pulse heating can be obtained by irradiating the specimen with a pulsed electron beam. The theory of the method is discussed; the results have been confirmed experimentally.

537.311.33 : 546.289 : 535.215 **3435**

Photoconductivity in Manganese-Doped Germanium.—R. Newman, H. H. Woodbury & W. W. Tyler. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 613–617.) "Impurity photoconduction has been observed in n- and p-type Mn-doped germanium at low temperatures. The spectra are consistent with the published ionization energy values determined from conductivity data. High-resistivity n-type samples show high intrinsic photosensitivity and long response times at low temperatures. In such samples the intrinsic photocurrent could be quenched by a factor of $\sim 10^4$ with light in the 0·3 to 0·7 eV range. Intrinsic photoconductivity was found to vary more rapidly than linearly with light intensity over a limited range."

537.311.33 : [546.289 + 546.681] : 535.33/.34 **3436**

L-Spectra of Gallium and Germanium.—A. Lemasson-Lucasson. (*C. R. Acad. Sci., Paris*, 25th June 1956, Vol. 242, No. 26, pp. 3059–3061.)

537.311.33 : 546.289 : 538.63 **3437**

An Investigation of the Nernst Effect in Germanium.—T. V. Krylova & I. V. Mochan. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2119–2121.) A report is presented on an experimental investigation. One of the conclusions reached is that the mobility of holes varies as $T^{-5/2}$.

537.311.33 : 546.289 : 539.16 **3438**

Effects of Gamma Radiation on Germanium.—J. W. Cleland, J. H. Crawford, Jr, & D. K. Holmes. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 722–724.) Experiments with high-purity n- and p-type specimens are reported. The extrinsic electron concentration of n-type material decreased at a rate only about 10^{-3} of that for fast-neutron irradiation. Extended exposure converts n-type material to p-type. For p-type material the rate of removal of carriers is much lower than for n-type. The value deduced for the cross-section for atomic displacements is about $1{\cdot}5 \times 10^{-26}$ cm^2.

537.311.33 : 546.47.241 **3439**

Electrical Properties of Zinc Telluride.—B. I. Boltaks, O. A. Matveev & V. P. Savinov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2097–2103.) An experimental investigation is reported; the main conclusions are as follows: ZnTe is a semiconductor of p type, with an energy gap of 0·65 ± 0·03 eV. Its electrical properties are greatly affected by atmospheric oxygen. There is a peculiar temperature dependence of the coefficient of thermo-e.m.f. for specimens with a composition close to the stoichiometric value. The mobility of holes is 30–50 cm/sec per V/cm, and varies with temperature in proportion to $T^{-3/2}$. The effective mass of a hole is about 0·2 of the mass of a free electron.

537.311.33 : 546.48.241.1 : 535.215 : 535.37 **3440**

Luminescence, Transmission and Width of the Energy Gap of CdTe Single Crystals.—C. Z. van Doorn & D. de Nobel. (*Physica*, April 1956, Vol. 22, No. 4, pp. 338–342.) Luminescence with a maximum at about 8 880 Å was obtained on illuminating a CdTe single crystal and on biasing a CdTe p-n junction in the forward direction. Possible mechanisms giving rise to the luminescence are indicated. The width of the energy gap determined from measurements of the spectral transmission of a single crystal is 1·51 eV at room temperature.

537.311.33 : 546.561-31 **3441**

Resistance of Metal/Semiconductor Contact at High Contact-Potential Differences.—N. A. Gozhenko & Yu. M. Altaiski. (*Zh. eksp. teor. Fiz.*, Feb. 1956, Vol. 30, No. 2, pp. 401–402.) Measurements of the contact resistance of (*a*) Cu_2O/Al and (*b*) Cu_2O/Cu, show that as the air pressure is increased from zero to about 20 mm Hg the resistance in case (*a*) first decreases and then increases, and in case (*b*) increases monotonically. The contact potential in case (*a*) is 1·18 V, in case (*b*) 0·22 V. The anomalous behaviour of the contact resistance in case (*a*) is discussed.

537.311.33 : 546.561-31 : 548.25 **3442**

The Intergrowth of Cu and Cu_2O after Oxidation and Reduction.—G. Jellinek, E. Menzel & C. Menzel-Kopp. (*Z. Naturf.*, Sept./Oct. 1955, Vol. 10a, Nos. 9/10, pp. 802–803.)

537.311.33 : 546.682.86 **3443**

Contribution to the Study of Carrier Mobility in InSb.—J. Tavernier. (*C. R. Acad. Sci., Paris*, 4th June 1956, Vol. 242, No. 23, pp. 2707–2710.) Measurements were made of the temperature variation of resistance and Hall constant for a p-type specimen in which the temperature of inversion of the Hall effect was not much below room temperature. Results are shown graphically. An approximate formula is derived giving the variation with applied magnetic field of the ratio of electron mobility to hole mobility; a value of 15·5 kG is hence calculated for the magnetic field strength at which the Hall effect disappears at room temperature. The observed value is 14 kG.

537.311.33 : 621.317.799 **3444**

Apparatus for Measurement of Hall Effect and Magnetoresistance in Semiconductors.—G. Della Pergola & D. Sette. (*Alta Frequenza*, April 1956, Vol. 25, No. 2, pp. 140–151.) The apparatus described permits measurements at values of magnetic induction up to about 1·3 Wb/m^2. Measurements on an n-type Ge specimen are reported.

537.311.33 : 669.046.54/.55 **3445**

Zone-Melting Processes for Compounds AB with a Measurable Vapour Pressure under Influence of the Atmosphere.—J. van den Boomgaard. (*Philips Res. Rep.*, April 1956, Vol. 11, No. 2, pp. 91–102.) Conditions under which purification by zone melting is possible are investigated. The relation between the deviation from stoichiometric composition and the position along the rod of material is derived. See also 2810 of September.

537.312.62 : 538.222 **3446**

Paramagnetic Effect in Superconducting Tin, Indium, and Thallium.—J. C. Thompson. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1004–1008.) "Measurements have been carried out on the longitudinal magnetization of pure rods in the intermediate state between normal and superconduction. The observed 'paramagnetic' flux increase is dependent on the externally sustained current, external magnetic field, and temperature only."

538.22 **3447**

Superexchange Interactions and Magnetic Lattices of the Rhombohedral Sesquioxides of the Transition Elements and their Solid Solutions.—Yin-Yuan Li. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1015–1020.)

538.221 **3448**

Magnetic Dispersion and Absorption of Iron between 0 and 7 000 Mc/s.—E. Naschke. (*J. Phys. Radium*, April 1956, Vol. 17, No. 4, pp. 330–337.) The variation of initial permeability with frequency was studied by measurements on wire specimens in which the size of the individual domains had been increased by heat treatment so as to shift the ferromagnetic dispersion due to wall movements to a frequency range lower than that associated with electron-spin rotation. The results are discussed in relation to various theories on magnetic dispersion due to wall movements.

538.221 **3449**

Magnetization of a Magnetic Single Crystal near the Curie Point.—D. O. Smith. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 959–963.) Experimental technique is described which enables an unambiguous indication to be obtained of spontaneous and induced magnetization of a single domain at temperatures around the Curie point. The magnetization/magnetizing-field (M/H) curves in this temperature region are highly non-linear; replotting in the form of H/T curves shows that the magnetic energy is proportional to M^3.

538.221 : 538.24 **3450**

Magnetization Curves and Domain Structure.—L. F. Bates & A. Hart. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, pp. 497–505.) The theoretical work of Lee (117 of 1954) on domain structure has been supplemented by an experimental study of the changes in domain patterns in a Néel-cut crystal of Si-iron occurring when the crystal dimensions are changed. Calculated magnetization curves based on the results show better agreement with experimental curves than has been obtained previously, particularly for low field strengths. A substantial hysteresis loss occurs in strong fields with crystals of finite size.

538.221 : 621.318.12 **3451**

The Effect of substituting Al^{3+} Ions for Fe^{3+} Ions on the Magnetic Properties of the Compounds ($6Fe_2O_3$, BaO), ($6Fe_2O_3$, SrO), ($6Fe_2O_3$, PbO).—C. Guillaud & G. Villers. (*C. R. Acad. Sci., Paris*, 11th June 1956, Vol. 242, No. 24, pp. 2817–2820.) Experimental results indicate that the effect of the substitution is to increase the coercive force, to reduce the saturation moment, and to modify the shape of the magnetization curve. Crystals with grain dimensions $< 0{\cdot}5\,\mu$ are obtained by appropriate heat treatment.

538.221 : 621.318.124 **3452**

Neutron Diffraction Observation of Heat Treatment in Cobalt Ferrite.—E. Prince. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 674–676.) Results of experiments indicate that, when heat treatment is applied in a magnetic field, the magnetic moments are in general displaced from the directions which would be expected from considerations of crystal anisotropy alone.

538.221 : 621.318.134 **3453**

The Metallography of Ferrites.—P. Levesque & L. Gerlach. (*J. Amer. ceram. Soc.*, 1st March 1956, Vol. 39, No. 3, pp. 119–120.) A note on the preparation and etching of ferrite specimens for displaying grain size, grain orientation and porosity.

538.221 : 621.318.134 **3454**

Ordering and Antiferromagnetism in Ferrites.—P. W. Anderson. (*Phys. Rev.*, 15th May 1956, Vol. 102, No. 4, pp. 1008–1013.) "The octahedral sites in the spinel structure form one of the anomalous lattices in which it is possible to achieve essentially perfect short-range order while maintaining a finite entropy. In such a lattice nearest-neighbor forces alone can never lead to long-range order, while calculations indicate that even the long-range Coulomb forces are only 5% effective in creating long-range order. This is shown to have many possible consequences both for antiferromagnetism in 'normal' ferrites and for ordering in 'inverse' ferrites."

538.221 : 621.318.134 **3455**

Magnetic Measurements on Individual Microscopic Ferrite Particles near the Single-Domain Size.—A. H. Morrish & S. P. Yu. (*Phys. Rev.*, 1st May 1956, Vol. 102, No. 3, pp. 670–673.) Measurements made with the quartz-fibre torsion balance described previously [2155 of July (Yu & Morrish)] provide evidence confirming the existence of single-domain particles; the critical size is in agreement with that found from theory (170 of January).

538.221 : 621.318.134 **3456**

The Temperature-Dependent Resistivity of certain Iron-Deficient Magnesium Manganese Ferrites.—W. P. Osmond. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 665–666.) Results reported by Blackman & Sherry (1468 of May) are interpreted as indicating that the firing temperature was not high enough to ensure complete oxygen compensation for the reduced Fe_2O_3 content.

538.221 : 621.318.134 **3457**

The Reduction of Eddy-Current Losses in Manganese-Zinc Ferrites by Addition of Calcium.—C. Guillaud, M. Paulus & R. Vautier. (*C. R. Acad. Sci., Paris*, 4th June 1956, Vol. 242, No. 23, pp. 2712–2715.) An experimental investigation has been made of the effect of introducing a small proportion of Ca, using a radioactive isotope to facilitate study of the diffusion. The Ca apparently diffuses preferentially in the joins between the crystal grains, thus increasing the resistance of the ferrites and reducing the eddy-current losses.

538.221 : 621.318.134 : 538.652 **3458**

Influence of Magnetostriction on the Initial Permeability of Manganese-Zinc Ferrites.—R. Vautier. (*C. R. Acad. Sci., Paris*, 11th June 1956, Vol. 242, No. 24, pp. 2814–2817.) Theoretical considerations and experimental results indicate that it is not possible to predict the initial permeability of polycrystalline Mn-Zn ferrites from measurements of the longitudinal magnetostriction. Measurements on single crystals, parallel to the crystal axes, may be more conclusive.

538.221.023 **3459**

Approximate Representation of Magnetization Curves by Simple Algebraic or Transcendental Functions.—J. Fischer & H. Moser. (*Arch. Elektrotech.*, 17th April 1956, Vol. 42, No. 5, pp. 286–299.) Fifteen different functions used as approximations to the experimentally determined B/H curves are discussed, and conclusions are tabulated regarding the range of conditions over which these approximations are useful.

549.514.5 : 537.531 : 535.21-31 **3460**

The Effect of U.V. and X-Ray Radiation on Silicate Glasses, Fused Silica and Quartz Crystals.—A. Kats & J. M. Stevels. (*Philips Res. Rep.*, April 1956,

Vol. 11, No. 2, pp. 115–156.) The results of an experimental investigation into the effect of irradiation on the structure of these SiO_2 compounds are given and discussed in terms of nomenclature introduced previously [*ibid.*, pp. 103–114 (Stevels & Kats)]. A table indicates absorption bands associated with certain of the imperfections noted.

621.318.134 : 546.3 : 669.05 **3461**

Preparation of Alkali Ferrites, Nickelites and Cobaltites by Fusion Electrolysis.—M. Dodero & C. Déportes. (*C. R. Acad. Sci., Paris*, 18th June 1956, Vol. 242, No. 25, pp. 2939–2941.)

666.1.037 **3462**

Solder Glass Sealing.—R. H. Dalton. (*J. Amer. ceram. Soc.*, 1st March 1956, Vol. 39, No. 3, pp. 109–112.) The development of low-melting-point glasses suitable for soldering ordinary glasses is described, together with some techniques used in making such seals.

MATHEMATICS

517.5 **3463**

Convenient Calculation Procedure for the Harmonic Analysis and Synthesis of Periodic Waves.—R. Chocholle. (*Rev. sci., Paris*, Jan.–March 1954, Vol. 92, No. 3325, pp. 3–14.) Simplification is effected by breaking down some operations and by grouping together identical operations.

517.9 **3464**

A Critical-Value Problem relative to a Nonlinear Differential Equation of Practical Importance.—A. Giger. (*Z. angew. Math. Phys.*, 25th March 1956, Vol. 7, No. 2, pp. 121–129.) Discussion of the equation

$$d^2\Theta/d\tau^2 + \alpha d\Theta/d\tau + \sin\Theta = \beta,$$

which arises e.g. in the analysis of the synchronization of oscillations. For every value of β within the range $0 < |\beta| < 1$ there exists a critical value α_0 of α such that for $\alpha > \alpha_0$ there is no periodic solution; the values of α_0 are calculated.

517.9 **3465**

A Solution of Tranter's Dual-Integral-Equations Problem.—J. C. Cooke. (*Quart. J. Mech. appl. Math.*, March 1956, Vol. 9, Part 1, pp. 103–110.) The solution of a pair of integral equations occurring in potential problems and previously studied by Tranter (695 of 1955) is given as an integral containing an unknown function which is determined by means of an integral equation of Fredholm's type.

517.9 **3466**

Round-Off Errors in Implicit-Finite-Difference Methods.—A. R. Mitchell. (*Quart. J. Mech. appl. Math.*, March 1956, Vol. 9, Part 1, pp. 111–121.) "Symmetrical and asymmetrical implicit finite difference replacements involving a variable parameter a and a variable mesh ratio s are considered for the heat conduction and wave equations, and expressions obtained for the round-off errors. It is found that the stable backward difference replacements, four-point for the heat conduction equation and five-point for the wave equation, give rise to minimum round-off errors."

519.21 : 621.396.621 **3467**

Notes on some Properties of Stationary Random Functions entering into Problems of Frequency Changing.—A. Blanc-Lapierre, P. Dumontet & M. Savelli. (*C. R. Acad. Sci., Paris*, 11th June 1956, Vol. 242, No. 24, pp. 2799–2800.)

MEASUREMENTS AND TEST GEAR

529.78 **3468**

Construction and Performance of New Quartz Clocks at the Physikalisch-Technische Bundesanstalt.—A. Scheibe, U. Adelsberger, G. Becker, G. Ohl & R. Süss. (*Z. angew. Phys.*, April 1956, Vol. 8, No. 4, pp. 175–183.) Frequency stability has been improved as a result of modifications in the method of supporting the quartz rod, the arrangement of electrodes, the internal thermostat, the master-oscillator circuit, and the frequency-divider circuit. In clocks P1 and P3 the frequency variation associated with aging is < 1 part in 10^9 in a month.

531.761 + 529.7 **3469**

Atomic Time and the Definition of the Second.—L. Essen. (*Nature, Lond.*, 7th July 1956, Vol. 178, No. 4523, pp. 34–35.) Difficulties inherent in the establishment of a single unit of time, as advocated by Pérard (2834 of September), are discussed. Tentative proposals are advanced, implementation of which would make the atomic standard immediately available while preserving a single unit of time closely linked with, although not defined by, that given by astronomical observations.

621.317.3.029.6 : 621.317.7.029.6 **3470**

The Technique of Microwave Measurements.—(*J. Brit. Instn Radio Engrs*, July 1956, Vol. 16, No. 7, pp. 385–400.) Report of a discussion dealing with the measurement of power, attenuation, impedance, frequency and dielectric properties.

621.317.328 : 621.396.823 : 621.3.013.78 **3471**

A Method of making Screen-Room Measurements.—K. E. Mortenson & C. J. Truax. (*Elect. Engng, N.Y.*, April 1956, Vol. 75, No. 4, p. 326.) Digest of paper published in *Trans. Amer. Inst. elect. Engrs*, Part I, *Communication and Electronics*, Jan. 1956, Vol. 74, pp. 746–750. A method is described for determining the 'free-space' interference field strengths of electrical equipment from measurements made in a screened room. The limitations of the method are: (*a*) the size of the equipment must be less than one third of the room size and the linear dimensions must be less than one tenth of the wavelength used, and (*b*) the frequency used should be about half the lowest resonant mode of the room.

621.317.328.029.62/.63 : 621.396.621.54 **3472**

A V.H.F./U.H.F. Field-Strength Recording Receiver using Post-Detector Selectivity.—Harvey, Newell & Spencer. (See 3528.)

621.317.33 **3473**

A Slide-Wire Cylinder for the Townsend Circuit as a Simple Adjunct in the Precision Measurement of Very High Resistances.—H. Mette. (*Z. angew. Phys.*, April 1956, Vol. 8, No. 4, pp. 191–193.)

621.317.33 : 621.375.4 : 621.314.7 **3474**

Measurement of the Input Resistance and Reactance of a Transistor Amplifier by varying the Impedance of an Oscillator.—A. P. Teplova, V. M. Tuchkevich & A. I. Uvarov. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2112–2118.) A simple method is described which involves connecting an oscillator to the transistor input and varying the impedance of the oscillator. The theory of the method is discussed and measurements at frequencies up to 10 Mc/s are reported.

621.317.335.2 : 621.318.42 **3475**

Measurement of the Self-Capacitance of an Inductor at High Frequencies.—J. P. Newsome. (*Electronic Engng*, August 1956, Vol. 28, No. 342,

pp. 350–352.) The methods of measurement discussed include one based on the determination of the self-resonance frequency of the inductor by use of a Q meter; this is particularly useful for small values of self-capacitance.

621.317.337 : 621.372.41 **3476**

Measurement of the Electrical Equivalent-Circuit Constants of High-Q Resonators.—E. Frisch. (*Nachrichtentech. Z.*, April 1956, Vol. 9, No. 4, pp. 182–185.) A method of determining the equivalent LCR values of ferrite-rod and piezoelectric resonators is described, involving frequency and impedance measurements. Other methods are reviewed.

621.317.34.018.782.4 **3477**

Error Sources in Group-Delay Measurements on Electric Networks.—A. van Weel. (*Philips Res. Rep.*, April 1956, Vol. 11, No. 2, pp. 81–90.) "Errors in group-delay measurements can be caused by spurious phase modulation in the amplitude modulator or in the network under test, by a varying carrier-frequency level on the detector, and by overloading the network under test. These effects are discussed and counter measures are indicated."

621.317.35 : 621.372.5.012 **3478**

A Sensitive Method for the Measurement of Amplitude Linearity.—S. I. Kramer. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1059–1060.) The method outlined is based on applying a linear sawtooth waveform to the input terminals of the device under test and passing the output through a differentiator; the differentiated waveform is observed oscillographically, departure from linearity being indicated by departure of the c.r.o. trace from the horizontal.

621.317.373 **3479**

A Simple Method of Accurate Phase Measurement of a Four-Terminal Network.—B. Chatterjee. (*J. Instn Telecommun. Engrs, India*, March 1956, Vol. 2, No. 2, pp. 93–95.) Brief description of a method in which the change of phase produced by a quadripole is measured by inserting the quadripole in the feedback loop of an oscillating circuit and noting the resulting frequency change.

621.317.4 : 539.152.1 : 538.569.4 **3480**

A Nuclear-Resonance Meter for Magnetic Flux.—V. Andresciani & D. Sette. (*Ricerca sci.*, April 1956, Vol. 26, No. 4, pp. 1101–1115.) An instrument for measurement of flux values between 0·15 and 1·2 Wb/m² is described; a transitron oscillator is used.

621.317.42 : 538.632 **3481**

Measurements on Magnetically Soft Materials by means of the Hall Generator.—F. Assmus & R. Boll. (*Elektrotech. Z., Edn A*, 11th April 1956, Vol. 77, No. 8, pp. 234–236.) Small Hall generators made of Group III–V alloys were used in several applications involving the measurement of magnetic field strengths in the range 0·1–10 oersted. The applications briefly described include measurement of the field strength in individual crystals of a silicon-iron rectangular-frame specimen, the magnetization of strips of metal, etc. The technique is particularly useful for indicating local variations.

621.317.443.029.5/.62 **3482**

Advances in the Design and Application of the Radio-Frequency Permeameter.—A. L. Rasmussen, A. W. Enfield & A. Hess. (*J. Res. nat. Bur. Stand.*, May 1956, Vol. 56, No. 5, pp. 261–267.) The instrument described previously [1857 of 1954 (Haas)] has been further developed. The frequency range covered is 0·05–50 Mc/s. In the range 0·1–35 Mc/s the accuracy of permeability determinations obtained from reference to a primary standard is within ± 2%.

621.317.444 **3483**

Development of a Vibrating-Coil Magnetometer.—D. O. Smith. (*Rev. sci. Instrum.*, May 1956, Vol. 27, No. 5, pp. 261–268.) An alternating voltage proportional to the magnetic field of a dipole created by inserting a small sample of magnetic material into a magnetizing field is derived by means of a coil vibrating along the axis of the dipole at a distance up to 2 cm from the sample. Measurements are continuous and recordable; accuracy is within 1% for a dipole moment of $8{\cdot}56 \times 10^{-4}$ A.m².

621.317.7 : 537.54 : 621.396.822.029.6 **3484**

The Gas-Discharge Tube as a Device for Noise Measurement in the Centimetre Waveband.—W. Klein & W. Friz. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 589–600. In German.) The production of white noise in the electron plasma of the self-supporting gas discharge is explained on the basis of thermodynamic theory. The available noise power for a discharge with purely electronic absorption corresponds to the full energy value of the electron temperature.

621.317.725 : 621.375.23.024 **3485**

Unity-Gain Voltmeter Amplifier.—H. R. Hyder. (*Tele-Tech & Electronic Ind.*, April 1956, Vol. 15, No. 4, pp. 84–85.) Circuit details are given of a highly stable three-stage d.c. amplifier incorporating differential first stage and cathode-follower output, suitable as a coupling unit between a high-impedance source and a low-impedance load; with a 0–1-V voltmeter connected across the output, ranges of 1 to 1 000 V are obtainable.

621.317.725 : 621.385 **3486**

Improved Slide-Back Valve Voltmeter.—O. E. Dzierzynski. (*Wireless World*, Sept. 1956, Vol. 62, No. 9, pp. 441–445.)

621.317.727 **3487**

A Switch-Dial Potential Divider.—W. K. Clothier. (*J. sci. Instrum.*, May 1956, Vol. 33, No. 5, pp. 196–198.) Variants of a general class of divider network are described in which the errors due to switch contacts are small, making them specially suitable for low-resistance applications.

621.317.729 : 621.396.823 **3488**

Equipment for recording R.F. Interference due to High-Voltage Power Transmission Lines.—J. Carteron, E. Fromy & B. Prokocimer. (*Rev. gén. Élect.*, April 1956, Vol. 65, No. 4, pp. 203–208.) Equipment for ground measurements of the field strength due to corona effects comprises (*a*) a small vertical aerial fixed directly to the metal case enclosing (*b*) an amplifier with a small number of circuits tuned to the fixed operating frequency, (*c*) a quasi-peak detector, and (*d*) a continuous electro-mechanical recorder actuated by a d.c. amplifier of the type described by Chevallier & Prokocimer (3316 above) in which stable operation is achieved by using a high degree of feedback distributed between the stages.

621.317.742 **3489**

A New Technique for the Measurement of Microwave Standing-Wave Ratios.—A. C. MacPherson & D. M. Kerns. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1024–1030.) A high-precision method using a stationary detector and sliding load is described. Generator, detector and load are connected respectively to the arms of a three-arm waveguide junction. The

variation of the detector response as the phase of the load is varied yields a curve similar to a standing-wave pattern, from which the unknown load can be determined using the procedure indicated. The technique is amenable to rigorous theoretical analysis.

621.317.755 **3490**

Increasing the Accuracy of C.R.O. Measurements.—T. H. Bonn. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, p. 1062.) Techniques in which the c.r.o. is used as a null detector yield accuracies within $\pm 0{\cdot}1\%$.

621.317.755 **3491**

An Automatic Cathode-Ray-Oscilloscope Beam-Brightening Device for Transient Recordings.—O. H. Davie: J. Wood. (*J. sci. Instrum.*, May 1956, Vol. 33, No. 5, p. 203.) Comment on 860 of March and author's reply. Modifications to the original device are suggested.

621.317.755 : 537.52 **3492**

The Production of a Short-Duration Pulse of High-Velocity Electrons.—D. H. Le Croissette. (*Electronic Engng*, August 1956, Vol. 28, No. 342, pp. 356–358.) A pulse of duration $0{\cdot}2\ \mu s$, used for initiating ionization in a gas-filled system, is obtained by making an electron beam traverse a hole in a steel plate; the operation is synchronized with an oscillograph timebase, thus permitting the simultaneous display of the ionizing pulse and the resulting discharge build-up.

621.317.761 **3493**

The 'Frequency Microscope', a Recording Frequency-Measuring Instrument with Very High Sensitivity.—G. Ohl. (*Arch. elekt. Übertragung*, April 1956, Vol. 10, No. 4, pp. 145–150.) A precision method of using a drum-type chronograph is described. The beat produced by two signals with nearly equal frequencies is used to trace a sequence of marks on the drum, the rate of rotation of which is controlled by a quartz crystal and is adjustable in discrete steps. The heterodyne frequency can be accurately determined by the graphical method described.

621.317.761 : 621.314.7 **3494**

Transistor Frequency Meters.—L. R. Blake & A. R. Eames. (*Electronic Engng*, August 1956, Vol. 28, No. 342, pp. 322–327.) Based on the switched-capacitor method, using a transistor switch, the meter described covers the range 0·3–100 kc/s in six sub-ranges, giving an accuracy within 0·5–1%. The indication is independent of signal level or waveform.

621.317.763.029.6 **3495**

The Generation of Multiple TE_{mo} and TM_{mo} Modes between Parallel Plates and in Rectangular Waveguides by Interference, and its Application to the Measurement of Wavelength.—J. I. Caicoya. (*Rev. Telecomunicación, Madrid*, March 1956, Vol. 11, No. 43, pp. 2–30. In Spanish and English.) Detailed analysis is presented for the reflection of microwaves at plane surfaces and the generation of multiple modes by interference. The basic experimental system comprises a pair of parallel rectangular plates with variable separation, arranged symmetrically with respect to a reference plane, and a third parallel rectangular plate whose position is adjusted independently to effect the auxiliary reflection required to produce interference. Horns with variable angular position are used as signal source and detector. Wavelength is determined from the settings for zero detected energy. The instrument has a wide operating frequency band.

621.317.784.029.3 **3496**

Electronic Wattmeter with Wide Frequency Range.—T. J. Schultz. (*Rev. sci. Instrum.*, May 1956, Vol. 27, No. 5, pp. 278–279.) A dynamometer movement is employed, the input to the two coils being supplied by independent power amplifiers using voltage and current negative feedback. Frequency response is level to within $\pm 0{\cdot}17$ dB between 20 c/s and 20 kc/s.

621.317.799 : 537.311.33 **3497**

Apparatus for Measurement of Hall Effect and Magnetoresistance in Semiconductors.—Della Pergola & Sette. (See 3444.)

621.317.799 : 621.385.029.6 : 621.396.96 **3498**

Magnetron Tester detects Lost Pulses.—P. Koustas & D. D. Mawhinney. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 164–168.) Radar magnetron output pulses of incorrect frequency, or inadequate amplitude or width, are detected by a coincidence meter in which the output is sampled and analysed, and are compared with a signal derived from the magnetron modulator circuit.

621.319.4(083.74) **3499**

New Variable Capacitors with Zero Initial Capacitance.—G. Zickner. (*Z. angew. Phys.*, April 1956, Vol. 8, No. 4, pp. 187–191.) Two types of standard capacitor are described in which the capacitance between two fixed plate systems is varied by means of a rotatable screen. These capacitors have three terminals, and are hence only suitable for use in certain types of circuit, such as bridges. The time stability is equal to that of fixed standard air capacitors, and the capacitance is more precisely defined than in capacitors with only one set of plates connected to the case.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.768 : 534.86 **3500**

Calibration of Vibration Pickups at High Frequencies using a Michelson Interferometer.—S. M. Davies. (*Nature, Lond.*, 21st July 1956, Vol. 178, No. 4525, p. 161.)

621.316.825 : 621.317.39 **3501**

The Use of Semiconductors in investigating Natural Phenomena.—A. F. Chudnovski. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2122–2133.) Brief descriptions are given of the following measuring instruments based on the use of thermistors: (*a*) probe for measuring the temperature distribution in soil; (*b*) electropsychrometer for remote measurements; (*c*) 'thermospider' for measuring the average temperature of the soil surface; (*d*) thermo-anemometer; (*e*) instrument for determining the absolute air humidity; (*f*) instrument for direct measurements of small temperature differences and absolute humidity of the air; (*g*) microelectrometer for measuring the surface temperature of leaves and stalks of plants. General considerations underlying the operation of these instruments are discussed.

621.383.2 : 621.385.832 : 531.76 **3502**

Physical Bases of Electron-Optical Chronography.—E. K. Zavoiski & S. D. Fanchenko. (*C. R. Acad. Sci. U.R.S.S.*, 11th May 1956, Vol. 108, No. 2, pp. 218–221. In Russian.) Very short flashes of light can be measured by means of an electron-optical image converter in which the electron beam is deflected by a rapidly rotating electric or magnetic field. In the limiting case a circle of radius 5 cm is traced in 10^{-10} s; assuming a resolution of 300 lines/cm the shortest measurable time interval is 10^{-14} s.

621.384.611 **3503**

Cyclotron with Sectional Magnet.—E. M. Moroz. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1956, Vol. 108, No. 3, pp. 436–439. In Russian.) The principles of operation of a cyclotron using a magnet comprised of wedge-shaped sectors are discussed.

621.384.612 **3504**

Influence of Radiation on Synchrotron Oscillations of Electrons in Systems with Strong [alternating-gradient] **Focusing.**—A. N. Matveev. (*C. R. Acad. Sci. U.R.S.S.*, 21st May 1956, Vol. 108, No. 3, pp. 432–435. In Russian.)

621.387.424 **3505**

An Oxygen-Quenched Geiger-Müller Counter.—D. Srdoč. (*J. sci. Instrum.*, May 1956, Vol. 33, No. 5, pp. 185–186.)

621.398 **3506**

Determination of Visual Interpolation Errors in the Plotting of Curves from Commutated Data.—L. Katz. (*Trans. Inst. Radio Engrs*, Feb. 1955, Vol. TRC-1, No. 1, pp. 15–24.) The frequency and sampling-rate requirements of telemetering systems are discussed, in relation to the errors to be expected in interpolating between the measured points.

621.385.833 **3507**

Optique électronique I : Lentilles électroniques. [Book Review]—P. Grivet, M. Y. Bernard & A. Septier. Publishers: Bordas, Paris, 1955, 184 pp., 1450 Fr. (*Proc. phys. Soc.*, 1st May 1956, Vol. 69, No. 437B, p. 587.) A research monograph in which the theoretical exposition is supplemented by practical detail. "... the best short account of electron lenses that has yet appeared."

PROPAGATION OF WAVES

621.396.11 **3508**

On the Lateral Deviation of Radio Waves coming from Europe.—K. Miya & S. Kanaya. (*Rep. Ionosphere Res. Japan*, March 1956, Vol. 10, No. 1, pp. 1–8.) Measurements of reception in Japan with aerials pointing in various directions indicate that propagation often takes place along paths deviating from the great circle. The observations support the theory advanced previously (235 of January) that forward scattering at the earth's surface is involved.

621.396.11 : 523.5 **3509**

Some Properties of Oblique Radio Reflections from Meteor Ionization Trails.—O. G. Villard, Jr, A. M. Peterson, L. A. Manning & V. R. Eshleman. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 233–249.) Observations were made over a 960-km path using one transmitter on frequencies of 23·2, 46·4 and 92·8 Mc/s and a second transmitter located at various distances along and offset from the main propagation path and operating on adjacent frequencies. The percentage of the total time during which reflections were received was in accordance with theoretical expectations. Re-radiation from low-density trails was highly directional; the relatively infrequent high-density trails gave long-duration echoes which were much less directional and were subject to fading. Contours of constant correlation were highly elongated in the direction of the propagation path. See also 236 of January.

621.396.11 : 551.510.535 **3510**

Reflection of Radio Signals by the Ionosphere.—P. Poincelot. (*Ann. Télécommun.*, April 1956, Vol. 11, No. 4, pp. 70–80.) The propagation of plane waves in a stratified medium is analysed (*a*) for linear variation of ionization with height, and (*b*) for an exponential variation. Results for continuous waves are obtained first, and pulse propagation is then studied, using group-velocity theory; numerical examples are given. The influence of the longitudinal component of the earth's magnetic field is discussed. See also e.g. 3725 of 1955.

621.396.11 : 551.510.535 **3511**

Orientation of Aerial of Ionospheric Station.—Z. Ts. Rapoport. (*Zh. eksp. teor. Fiz.*, Feb. 1956, Vol. 30, No. 2, pp. 407–408.) The effect is calculated of the orientation relative to the magnetic meridian of the electric vector of the wave incident normally on the ionosphere (angle β) on the ratio of the average energy flux of the reflected ordinary wave (S_2) to that of the extra-ordinary wave (S_1). The curves showing (S_2/S_1) as a function of β are plotted with $|K_2|$, the polarization index of the ordinary wave, as parameter.

621.396.11 : 551.510.535 **3512**

Ionospheric Focussing and Image Zones.—B. D. Khurana. (*J. Instn Telecommun. Engrs, India*, March 1956, Vol. 2, No. 2, pp. 96–99.) "The desired target region of reception in short-wave broadcasting is covered by firing the radio waves from a suitably designed transmitting antenna, into the ionosphere, at predetermined angles. Analysis shows that in addition to the target region, some extra zones on the earth's surface also come to receive an appreciably enhanced signal strength. This so-called 'focussing' results from the curvature of the reflecting layers. The 'first order image zones' have been determined for the regional short-wave transmitters of AIR [All India Radio], and plotted on the great-circle map, as an illustration."

621.396.11 : 551.510.535 **3513**

Ionospheric Absorption at Dakar.—F. Delobeau & K. Suchy. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 45–50. In French.) Selective and nonselective absorption characteristics have been determined from measurements at Dakar. Nonselective absorption is proportional to D-layer electron density and follows the density variations with sunspot number. Variations of selective absorption are related to the observation that the collision frequency at mid-height of the E layer varies inversely as the sunspot number.

621.396.11 : 551.510.535 : 523.16 **3514**

On the Propagation of Radio Waves through the Upper Ionosphere.—G. R. Ellis. (*J. atmos. terr. Phys.*, July 1956, Vol. 9, No. 1, pp. 51–55.) "The low-frequency limit for the propagation of radio waves through the ionosphere is discussed. It is shown that reflection and absorption of extraordinary waves can occur well above the F region near the level where $f = f_H$, if the wave frequency is less than $f_H F_2$, and if the electron density near this level is not negligible. In these circumstances the low-frequency limit will be determined by $f_0 F_2$, and observations of cosmic radio emission at frequencies much below 1 Mc/s are unlikely."

621.396.11 : 621.396.91 **3515**

Time Signals for the Determination of Longitude.—W. H. Ward. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1064–1065.) In connection with determinations of longitude to be made during the International Geophysical Year, radio propagation velocities are required to be known with high accuracy. A method for determining this velocity is outlined, involving two pairs of transmitting and receiving stations and one land-line link.

621.396.11.029.45/.5 **3516**

Amplitude and Phase Curves for Ground-Wave Propagation in the Band 200 c/s to 500 kc/s.—J. R. Wait & H. H. Howe. (*Nat. Bur. Stand. Circulars*, 21st May 1956, No. 574, 17 pp.) Values of the field strength and phase at distances from 1 to 1 500 miles are computed, assuming a very short vertical radiator and ground conductivity values of 4, 0·01 and 0·001 mho/m.

621.396.11.029.6 **3517**

Marconi's Last Paper, 'On the Propagation of Microwaves over Considerable Distances'.—T. J. Carroll. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1056–1057.) An English translation is given of this paper, which was written in 1933 and describes experiments on the reception of 500-Mc/s signals at distances up to 258 km, almost nine times the optical distance.

621.396.11.029.6 **3518**

Reflection of Ultra-short Waves at Layer Inhomogeneities of the Troposphere.—V. N. Troitski. (*Radiotekhnika, Moscow*, Jan. 1956, Vol. 11, No. 1, pp. 7–16.) Reflection at oblique incidence is considered for a layer in which permittivity $\epsilon(z)$ varies with height in accordance with the formula $\epsilon(z) = \epsilon_0 - Ne^{az}(1 + e^{az})^{-1} - M.4e^{az}(1 + e^{az})^{-2}$, where ϵ_0 is the permittivity at the boundary and M, N, and a are characteristic parameters of the layer. The variation of the reflection coefficient with layer thickness is investigated. See also *ibid.*, May 1956, Vol. 11, No. 5, pp. 3–20.

621.396.11.029.6 : 551.510.535 : [523.16 + 523.5 + 551.594.5 **3519**

Review of Ionospheric Effects at V.H.F. and U.H.F.—C. G. Little, W. M. Rayton & R. B. Roof. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 992–1018.) The present state of knowledge on the following effects is summarized: radar echoes from aurora, radar echoes from meteors, the Faraday effect and radar echoes from the moon, radio noise of auroral origin, absorption of radio waves by the ionosphere, refraction of radio waves by the ionosphere, and the scintillation of radio stars. 182 references.

621.396.11.029.62 **3520**

V.H.F. Diffraction by Mountains of the Alaska Range. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1049–1050.) Report of reception at Lake Minchumina of 200-Mc/s television signals from Anchorage, 200 miles away on the far side of the mountain ridge. Measurements of field-strength distribution made from an aeroplane established a fine-structure diffraction pattern. Time variations of field strength and direction of arrival can be explained by changes in meteorological conditions over the paths of signal components scattered and/or diffracted by widely separated peaks. The results give substantial support to knife-edge theory.

621.396.11.029.62 : 551.510.535 **3521**

Oblique-Incidence Measurements of the Heights at which Ionospheric Scattering of V.H.F. Radio Waves occurs.—V. C. Pineo. (*J. geophys. Res.*, June 1956, Vol. 61, No. 2, Part 1, pp. 165–169.) From the differences in propagation times for pulses propagated along tropospheric and ionospheric paths between stations 810 km apart it is tentatively concluded that the operative scattering layers are at heights of 86 km and 70 km for the night-time and midday hours respectively.

621.396.11.029.63 **3522**

Propagation Tests at a Frequency of 1 000 Mc/s over Various Paths.—F. Vecchiacchi. (*Alta Frequenza*, April 1956, Vol. 25, No. 2, pp. 100–129.) Detailed report of tests made in northern and central Italy during the period 1951–1954. All the paths tested afforded optical visibility; the two longest were 189 km and 196 km respectively. The results indicate that wide-band communication can be maintained for a high percentage of the time. Field-strength fluctuations were much greater in summer than in winter, but on almost every day in summer there was a period of a few hours during which the amplitude of the fluctuations was reduced. Winter periods relatively free from fluctuations are associated with rainy weather.

621.396.812.029.62 + 621.397.62 + 621.396.677.3 **3523**

Long-Distance Television Reception in the U.S.S.R.—W. Sorokine. (*Télévision*, March/April 1956, No. 82, pp. 85–88.) Long digest of reports of amateur band-I reception published in *Radio, Moscow*, Nov. & Dec. 1955. Details and diagrams are given of one of the receivers and aerials used.

RECEPTION

621.376.23 : 621.396.822 **3524**

Some Points in the Theory of Square-Law Detection of Background Noise.—A. Blanc-Lapierre, P. Dumontet & M. Savelli. (*C. R. Acad. Sci., Paris*, 18th June 1956, Vol. 242, No. 25, pp. 2911–2913.) The spectrum of $X^2(t) + S^2(t)$ is studied, $X(t)$ being a stationary random Laplace function and $S(t)$ its transform in certain linear filters.

621.396.62 : 621.396.812.3 **3525**

The Statistics of Combiner Diversity.—H. Staras. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1057–1058.) An analytic method for evaluating the combined statistical distribution in terms of a tabulated function is discussed; results are presented graphically for the combined signal up to ten-fold diversity.

621.396.62.029.62 : 621.376.33 **3526**

Switched-Tuned F.M. Unit.—J. M. Beukers. (*Wireless World*, Sept. 1956, Vol. 62, No. 9, pp. 427–434.) A modified form of the receiver described by Amos & Johnstone (2096 of 1955) incorporates a reactance valve controlled by the error voltage from the ratio detector and in turn controlling the oscillator so as to provide a.f.c. Constructional details are given.

621.396.621.54 **3527**

Communications Receiver Type-BX 925A.—J. H. van Wageningen. (*Commun. News*, April 1956, Vol. 16, No. 3, pp. 92–98.) A single-heterodyne receiver for telegraphy or telephony is described; it has two stages of r.f. and two stages of i.f. amplification. Special features include the combination of mechanical band-spread with high-speed tuning by motor, and the provision of a crystal-controlled calibration oscillator.

621.396.621.54 : 621.317.328.029.62/.63 **3528**

A V.H.F./U.H.F. Field-Strength Recording Receiver using Post-Detector Selectivity.—R. V. Harvey, G. F. Newell & J. G. Spencer. (*B.B.C. Engng Div. Monographs*, April 1956, No. 6, pp. 1–26.) Design and performance details for a pre-tuned receiver for bands III and IV are discussed. A separate signal-frequency unit is used for each band, followed by a common i.f. unit working at 10·7 Mc/s. The output signal/noise ratio has been increased by restricting the bandwidth of the circuits following the detector, enabling a higher sensitivity to be obtained. The receiver has been designed for unattended operation over periods up to one month with a calibration stability within ± 1 dB.

621.396.621.54 : 621.385.5 **3529**

The Presentation and Application of the Characteristics of the Pentagrid Converter Valve.—Wilshire. (See 3590.)

621.396.621.54.029.45/.51 : 621.375.234 **3530**

A Very-Low-Frequency Receiver with High Selectivity.—C. S. Fowler. (*J. Brit. Instn Radio Engrs*, July 1956, Vol. 16, No. 7, pp. 401–404.) A superheterodyne receiver for the frequency band 6–36 kc/s is described. High selectivity is obtained by using mixed positive and negative feedback to control the Q factor of the i.f. tuned circuits.

621.396.82 : 621.397.62(083.74) **3531**

I.R.E. Standards on Methods of Measurement of the Conducted Interference Output of Broadcast and Television Receivers in the Range of 300 kc/s to 25 Mc/s, 1956.—(*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1040–1043.) Standard 56 I.R.E. 27.S1, supplement to 54 I.R.E. 17.S1.

621.396.823 : 621.317.729 **3532**

Equipment for recording R.F. Interference due to High-Voltage Power Transmission Lines.—Carteron, Fromy & Prokocimer. (See 3488.)

STATIONS AND COMMUNICATION SYSTEMS

621.396.3 : 621.396.43 : 523.5 **3533**

Janet [communication system].—W. T. Cocking. (*Wireless Engr*, Sept. 1956, Vol. 33, No. 9, p. 203.) Brief note on a long-range radiotelegraphy system developed by the Canadian Defence Research Board, in which the propagation path is provided by ionized meteor trails. Frequencies between 30 and 60 Mc/s are used, and transmitters with a power output of about 800 W are used with Yagi aerial systems having a gain of about 10 dB. Messages for transmission are recorded in readiness, and the actual transmission starts automatically when ionization occurs at the appropriate reflection point relative to transmitter and receiver. For another account, see *Wireless World*, Sept. 1956, Vol. 62, No. 9, pp. 404–405.

621.396.41 : 621.396.65.029.63 **3534**

A Decimetre-Wavelength Radio-Link Network providing High-Quality Program Channels using Pulse Phase Modulation: Part 1—Transmission Requirements, Planning and Results.—G. Brühl. (*Telefunken Ztg*, March 1956, Vol. 29, No. 111, pp. 5–12. English summary, pp. 62–63.) Description of the 500-mile Austrian network, which comprises 25 stations in six main sections. Carrier frequencies between 2·06 and 2·3 kMc/s are used; three 15-kc/s program channels and six 3·2-kc/s speech channels are accommodated. The overall signal/noise ratio is >66 dB.

621.396.71.029.55(43) **3535**

Federal German Post Office Overseas Radio Transmitting Station at Elmshorn.—E. Meinel. (*Nachrichtentech. Z.*, April 1956, Vol. 9, No. 4, pp. 151–158.) The station comprises 16 s.w. transmitters, including four 20-kW s.s.b. and two 50-kW d.s.b. telephony transmitters and ten 20-kW transmitters for telegraphy; 21 rhombic aerials and several horizontal dipole arrays are used. The equipment and services are briefly described.

621.396.97 : 621.396.677 **3536**

Vertical Radiation and Tropical Broadcasting.—A. H. Dickinson. (*J. Brit. Instn Radio Engrs*, July 1956, Vol. 16, No. 7, pp. 405–411.) An estimate, based on five years' operating experience, is presented of the requirements in respect of aerial design, transmitter power and operating frequencies for s.w. broadcasting stations in the tropics to serve the large areas outside the main population centres. Aerials comprising 16-element binomial arrays [2335 of 1952 (Adorian & Dickinson)] used in conjunction with 5-kW transmitters should be able to serve areas of 90 000 miles². Co-channel stations should be separated by 1 500 miles. Each station requires two or three frequencies in the 2·5-, 3·5-, 5- and 9-Mc/s bands, in order to cope with ionosphere variations, but the number of frequency changes should be kept to a minimum for the convenience of listeners.

SUBSIDIARY APPARATUS

621.311.6 **3537**

A Balanced, Unregulated, Dual Power Supply.—K. N. Hemmenway. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, p. 1053.) A circuit is described for simultaneously providing positive and negative voltages which remain equal in face of line-voltage variations; practical details are given for a unit supplying $\pm$ 300 V at 38·9 mA. A graph shows the performance of the unit used with a d.c. amplifier providing a balanced load.

621.311.6 : 621.314.63 : 537.311.33 : 535.215 **3538**

Semiconductor Solar-Energy Converters.—A. Hähnlein. (*Nachrichtentech. Z.*, April 1956, Vol. 9, No. 4, pp. 145–150.) A concise review of the physical fundamentals includes brief discussions of radiant-energy absorption in semiconductors, the effect of p-n junctions and the energy conversion efficiency.

621.311.61 : 621.314.1 : 621.314.7 **3539**

Efficient and Reliable Transistor High-Voltage Power Supply.—G. E. Driver. (*Nucleonics*, March 1956, Vol. 14, No. 3, pp. 74, 76.) The system comprises a 9-V battery, a transistor oscillator, crystal rectifier and corona-type regulator; the output is about 20 μA at 900 V.

621.314.634 **3540**

Life-Test Results on Selenium Rectifiers.—G. C. Chernish. (*Tele-Tech & Electronic Ind.*, April 1956, Vol. 15, No. 4, pp. 68–69 .. 169.) Tests on a representative selection of Se rectifiers for radio and television equipment show very great variations in shelf life, useful life and temperature characteristics; the need for drastic derating is suggested.

TELEVISION AND PHOTOTELEGRAPHY

621.397.242 : 621.397.743 **3541**

A 21-Mc/s Local Television Network.—H. J. Schmidt. (*Nachrichtentech. Z.*, April 1956, Vol. 9, No. 4, pp. 173–177.) The modulators, amplifiers and demodulators used in the coaxial-line network linking the studios, control rooms and transmitters located in various parts of Hamburg are discussed. A d.s.b. system with positive a.m. is used.

621.397.5 : 535.623 **3542**

Notes on a Colour-Television System with Two Amplitude-Modulated [sub-] **Carriers.**—J. Wolf. (*Elektronische Rundschau*, April 1956, Vol. 10, No. 4, pp. 101–104.) Factors relevant to the choice of colour subcarriers for a European system are discussed; it is shown that frequency interlace is not an essential prerequisite for the transmission of colour information within the luminance band. A simple method of fixing

the ratio between colour subcarrier and line frequency in the two-subcarrier system described by Haantjes & Teer (1224 of April) is indicated with reference to a suitable circuit.

621.397.5(083.74) **3543**

Television in the World Today.—C. J. Hirsch. (*Elect. Engng, N.Y.*, April 1956, Vol. 75, No. 4, pp. 321–325.) The various television standards in use are tabulated and briefly discussed.

621.397.6 : 621.397.7 : 535.623 **3544**

Pedestal Processing Amplifier for Television Studio Operation.—R. C. Kennedy. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 297–302.) "The pedestal processing amplifier is a device capable of removing the synchronizing pulses from either a colour or monochrome television signal so as to permit simultaneous presentation of pictures from separate locations. It utilizes a new type of sync separator which provides a sync signal having constant amplitude for input signal variations of ± 14 decibels."

621.397.61 **3545**

A Flat-Bed Facsimile Telegraph Transmitter.—W. D. Buckingham. (*Elect. Engng, N.Y.*, April 1956, Vol. 75, No. 4, pp. 356–359.) Experimental equipment is described in which the message sheet may be of any desired length, and is advanced slowly while scanning is effected by the forward sweep across the sheet of a light spot of diameter 0·01 in. The light is produced by a special type of tungsten arc lamp. A cylindrical reflector is used for concentrating the light reflected from the message sheet on the photocell.

621.397.61 : 535.623 **3546**

Colorimetry, Film Requirements and Masking Techniques for Color Television.—H. N. Kozanowski & S. L. Bendell. (*J. Soc. Mot. Pict. Telev. Engrs*, April 1956, Vol. 65, No. 4, pp. 201–204.) Basic requirements for transmission of colour films are discussed and improved equipment for electronic masking and hue control is described.

621.397.611.2 : 621.397.8 **3547**

The Possibility of a 'Normal' Resolution by Television Transmitting Tubes with Energy Storage.—Ya. A. Ryftin. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 25, No. 12, pp. 2214–2232.) 'Normal', or maximum attainable, resolution is defined and an analysis is made of the causes which lower the operational quality of storage tubes. The possibility of obtaining 'normal' resolution with this type of tube is discussed and some practical suggestions are made. A rough estimate is given of the extent to which existing storage tubes fail to provide full-quality service with 625-line scanning.

621.397.62 + 621.396.812.029.62 + 621.396.677.3 **3548**

Long-Distance Television Reception in the U.S.S.R.—Sorokine. (See 3523.)

621.397.62 : 535.623 **3549**

Color Purity in Ungated Sequential Displays.—G. S. Ley. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. BTR-1, No. 1, pp. 36–43. Abstract, *Proc. Inst. Radio Engrs*, March 1955, Vol. 43, No. 3, p. 383.)

621.397.62 : 535.623 **3550**

The Practical Aspects of the Color Subcarrier Synchronization Problem.—W. J. Gruen. (*Trans. Inst. Radio Engrs*, Jan. 1955, Vol. BTR-1, No. 1, pp. 44–51. Abstract, *Proc. Inst. Radio Engrs*, March 1955, Vol. 43, No. 3, p. 383.)

621.397.62 : 621.376.33 **3551**

Sampling Detector for Intercarrier TV Sound.—K. Schlesinger. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 138–141.) One half of a double triode is connected as a feedback oscillator, locked through the inductance of its tank circuit to a driver stage fed by the 4·5-Mc/s f.m. sound carrier. It is coupled through a common cathode connection to the sampling triode, which is arranged to function at zero passage of the carrier voltage, thus yielding maximum f.m. detection while ignoring residual a.m.

621.397.62 : 621.396.82(083.74) **3552**

I.R.E. Standards on Methods of Measurement of the Conducted Interference Output of Broadcast and Television Receivers in the Range of 300 kc/s to 25 Mc/s, 1956. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1040–1043.) Standard 56 I.R.E. 27.S1, supplement to 54 I.R.E. 17.S1.

621.397.621.2 : 535.623 : 621.385.832 **3553**

Effect of Magnetic Deflection on Electron-Beam Convergence [in colour-television tubes].—P. E. Kaus. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 168–189.) "The image curvatures of deflection yokes are calculated and minimized using third-order perturbation theory. It is found that the mean image curvature is too large to dispense with dynamic convergence when a point focus is needed. Proper field shaping, however, can produce a good line focus over the whole screen without dynamic convergence."

621.397.621.2 : 535.623 : 621.385.832 **3554**

Recent Improvements in the 21AXP22 Color Kinescope.—R. B. Janes, L. B. Headrick & J. Evans. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 143–167.) The location and formation of the phosphor dots on the face-plate of this three-gun tube [2771 of 1955 (Seelen et al.)] are effected in a special optical device called a 'lighthouse'. Modifications of this device leading to improved colour performance of the tube are described.

621.397.621.2 : 535.623 : 621.385.832 **3555**

Kinescope Electron Guns for producing Non-circular Spots.—Knechtli & Beam. (See 3593.)

621.397.7 : 621.397.6 **3556**

Standardization of Television Equipment at Radiodiffusion-Télévision Française.—L. Goussot. (*Onde élect.*, April–June 1956, Vol. 36, Nos. 349–351, pp. 352–368, 479–486 & 541–550.) Video-frequency equipment is considered to have reached a stable state of development; present practice is described. Component specifications and characteristics are detailed in an appendix.

621.397.5 : 535.623 **3557**

Color Television Engineering. [Book Review]—J. W. Wentworth. Publishers: McGraw-Hill, New York and London, $8 or 60s. (*Engineering, Lond.*, 13th April 1956, Vol. 181, No. 4701, p. 208.) "The outstanding value of the book is its clear presentation of fundamental colour theory and the marriage of this theory with that of television engineering."

TRANSMISSION

621.376.32 : 621.396.61 : 621.396.41 **3558**

Exciters multiplex F.M. Carriers.—H. G. Stratman. (*Electronics*, Aug. 1956, Vol. 29, No. 8, pp. 148–150.) The equipment consists of a f.m. exciter which provides a main carrier of frequency 100 Mc/s, using a serrasoid modulator circuit [342 of 1949 (Day)],

and a similar unit generating an audio-modulated subcarrier of frequency 32·5 kc/s to perform the multiplexing operation. The total audio distortion is < 0·2%, with a crosstalk figure of about − 55 dB.

621.396.61 : 621.375.232.4 **3559**

Linear 15-kW Amplifier with Grounded-Grid Stage.—A. Di Marco. (*Rev. telegr. Electronica, Buenos Aires*, March 1956, Vol. 44, No. 522, pp. 125–128.) A description is given of a two-stage amplifier for a transmitter. The second stage is cathode-excited, while the first stage is designed for class-AB1 operation. The gain is 50 dB. A vertical-panel construction system is used, giving good accessibility.

621.396.61 : 621.376.32 : 621.373.42 **3560**

The Gain Characteristic inside the Pull-In Range particularly in F.M. Transmitters and Wobbulators.—E. G. Woschni. (*Hochfrequenztech. u. Elektroakust.*, Nov. 1955, Vol. 64, No. 3, pp. 63–73.) Continuation of earlier work on the occurrence of pull-in ranges in f.m. transmitters and wobbulators controlled by reactance valves (*ibid.*, Dec. 1954, Vol. 63, No. 5, pp. 119–125). The dependence of the pull-in range on the residual attenuation is analysed. A formula is derived expressing the gain variation in terms of the maximum gain at the middle of the pull-in range and of the fractional detuning. Values of lock-in range and gain obtained experimentally are in some cases substantially higher than calculated values; the discrepancies are attributed to distortion introduced during the frequency-modulation process.

VALVES AND THERMIONICS

621.3·71 **3561**

Review of Industrial Applications of Heat Transfer to Electronics.—Kaye. (See 3290.)

621.314.63 : 621.314.7 **3562**

Low-Frequency Circuit Theory of the Double-Base Diode.—J. J. Suran. (*Trans. Inst. Radio Engrs*, April 1955, Vol. ED-2, No. 2, pp. 40–48.) A study is made of the operating mechanism of the single-junction semiconductor device with two ohmic contacts; large-signal operation is treated by applying small-signal theory to successive restricted regions of the characteristic, part of which exhibits negative resistance. Circuit parameters are related to the physical constants of the device.

621.314.7 **3563**

The Four-Terminal-Network Parameters of the Junction Transistor in the Three Basic Circuit Arrangements.—G. Meyer-Brötz. (*Telefunken Ztg*, March 1956, Vol. 29, No. 111, pp. 21–28. English summary, pp. 63–64.)

621.314.7 **3564**

Experimental Study of Point-Contact Transistor.—S. Iwase. (*Rep. elect. Commun. Lab., Japan*, Nov. 1955, Vol. 3, No. 11, pp. 27–33.) An account is given of the Ge surface treatment, and of experiments on the electrical forming of the transistor with different point-contact materials. Best characteristics are obtained with a collector containing 0·25%–1% of a Group-V impurity; the emitter substance should not be the same as the collector.

621.314.7 **3565**

A Junction Transistor with High Current Gain.—J. W. Granville. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 565–579.) The production and performance of a new transistor with a *p-n*-junction emitter and *n-n+*-junction collector are described and compared with the corresponding aspects of point-contact transistors. The *n-n+* junction is made by alloying a Sn-Sb alloy to the Ge, while the *p-n* junction is made by alloying In to the Ge. High noise factors, of the order of 60 dB, were observed in experimental *p-n-n+* transistors; possible methods of eliminating this and other drawbacks are mentioned. Use of Si instead of Ge could lead to improved performance.

621.314.7 : 621.375.4 **3566**

Measurement Considerations in High-Frequency Power Gain of Junction Transistors.—R. L. Pritchard. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1050–1051.) Reasons are given for the particular choice of methods used in the work described previously (3774 of 1955); the theory is extended to two types of neutralization used in common-emitter transistor amplifiers.

621.383.2 **3567**

The Time Lag and other Undesirable Phenomena observed in Vacuum Photo-tubes at Weak Illumination: Part 2.—M. Sugawara. (*J. phys. Soc. Japan*, March 1956, Vol. 11, No. 3, pp. 271–278.) A specially constructed cell, having a second, semitransparent cathode which can be insulated, is used to show that abnormal response characteristics in standard photocells can be explained by the adherence of photo-emissive material to the inner surfaces of the cell. Part 1: 2905 of September.

621.383.2 : 535.215.08 **3568**

Apparatus for the Study of Spectral Response of Photoelectric Surface.—H. Mitsuhashi & T. Nakayama. (*J. phys. Soc. Japan*, March 1956, Vol. 11, No. 3, pp. 308–311.) Constancy of the test source intensity is secured by a servomechanism controlled by comparison with a standard source. The photoelectric response is also recorded automatically.

621.383.2 : 621.396.822 **3569**

Flicker Noise in Vacuum Photoelectric Diodes.—R. J. J. Zijlstra & C. T. J. Alkemade. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 656–657.) Noise in photocells with Cs-Cs_2O-Ag and with Cs_3-Sb photocathodes was measured over the frequency range 1 c/s–1 kc/s. Results are presented graphically; they are consistent with the assumption that the frequency-dependent flicker noise superimposed on the shot noise is generated in a cathode layer whose resistance fluctuates with time.

621.383.2 : 681.142 **3570**

Bit Storage via Electro-optical Feedback.—Milch. (See 3289.)

621.385 : 621.3.015.3 **3571**

Theory of Transient Processes in Electronic Devices and in Circuits containing such Devices.—G. A. Grinberg. (*Zh. tekh. Fiz.*, Oct. 1955, Vol. 26, No. 12, pp. 2183–2192.) A mathematical analysis is given of the rise of the current in an electronic device on application of a pulse voltage. The case of a plane diode with a direct voltage suddenly applied is considered in detail.

621.385.002.2 **3572**

Techniques for the Manufacture and Inspection of Reliable Electronic Valves.—J. Brasier. (*Le Vide*, March/April 1956, Vol. 11, No. 62, pp. 66–77.) U.S.A. procedure for preparing specifications for reliable valves is indicated; the distinction between specifications

applicable during actual manufacture and those applicable during a subsequent inspection is emphasized. French official specifications and the manufacturing steps taken to satisfy them are described and illustrated.

621.385.029.6 **3573**

Plasma-Frequency Reduction Factors in Electron Beams.—G. M. Branch & T. G. Mihran. (*Trans. Inst. Radio Engrs*, April 1955, Vol. ED-2, No. 2, pp. 3–11.) Long-beam microwave valves are discussed. The plasma-frequency reduction factor due to the presence of the drift-tube walls is calculated for a variety of beam and drift-tube cross-sections, and the results are presented in a series of graphs. One particular result is that for an annular beam the reduction factor depends primarily on the width of the annulus.

621.385.029.6 **3574**

Modern Reflex Klystrons.—R. Hechtel. (*Arch. elekt. Übertragung*, April 1956, Vol. 10, No. 4, pp. 133–138.) The construction and performance characteristics of an experimental klystron with an output of 4–5 W in the 3·6–4·2-kMc/s frequency band are compared with those of the U.S.A. types RK 5976 and 431A.

621.385.029.6 **3575**

Travelling-Wave Valves for 4-cm Waves: Research and Development at the Centre National d'Études des Télécommunications.—A. Bobenrieth & O. Cahen. (*Onde élect.*, April 1956, Vol. 36, No. 349, pp. 307–317.) The design and production of valves to the specifications of the French Post Office are described. Characteristics of an experimental model are given; saturation power is > 1 W at 7·0–7·5 kMc/s, varying only slightly with frequency, for inputs of about 0·3 mW.

621.385.029.6 **3576**

Recent Developments of O-Type Carcinotrons.—P. Palluel. (*Onde élect.*, April 1956, Vol. 36, No. 349, pp. 318–335.) A range of six models developed by the Compagnie Générale de T.S.F. covers the range 1–15 kMc/s; details are given of construction and performance. See also 1904 of June (Palluel & Goldberger).

621.385.029.6 **3577**

When is a Backward Wave not a Backward Wave?—J. E. Rowe & G. Hok. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1060–1061.) A critical discussion of some methods of analysing the large-signal operation of travelling-wave valves.

621.385.029.6 : 621.396.822 **3578**

Noise in Traveling-Wave Tubes.—A. G. Mungall. (*Trans. Inst. Radio Engrs*, April 1955, Vol. ED-2, No. 2, pp. 12–17.) Noise measurements on valves for operation at 3·2 cm λ are reported. The effects of anode-to-helix separation, space charge, field distribution and gas pressure are studied. A modified theory of space-charge smoothing of microwave shot noise is suggested. Possible improvement of noise figure by use of a triode gun in place of a diode is discussed.

621.385.029.6 : 621.396.822 **3579**

The Noise Factor of Traveling-Wave Tubes.—G. Hok. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, p. 1061.) Discussion indicates that no theoretical lower limit for the noise factor is found when a simple mathematical model with appropriate means for shaping the beam is chosen.

621.385.032.2 **3580**

Effect of Cathode Roughness on the Maximum Current Density in an Electron Beam.—G. W. Preston. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 627–630.) Analysis indicates that the current density in a focused beam may be greatly reduced due to roughness of the cathode surface; the minimum beam diameter attainable is unaffected by change of cathode temperature or proportional changes in the potentials of all electrodes.

621.385.032.21 : 537.5 **3581**

High-Frequency Oscillations in the Space Charge of some Electron Emission Systems.—K. T. Dolder & O. Klemperer. (*J. Electronics*, May 1956, Vol. 1, No. 6, pp. 601–611.) "The occurrence of multiple electron sources in electron emission systems was investigated for thermionic filamentary cathodes in the form of a straight wire, of a hairpin and of a helical spiral. The experimental results are all consistent with the view that the occurrence of multiple sources is the result of standing electron space charge oscillations close to the cathode surface. The frequencies of these oscillations are believed to be between 10^8 and 10^9 c/s."

621.385.032.212 : 621.396.822 **3582**

Electron-Beam Noisiness and Equivalent Thermal Temperature for High-Field Emission from a Low-Temperature Cathode.—R. W. DeGrasse & G. Wade. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1048–1049.) Analysis indicates that the noise-equivalent temperature of a field-emission cathode at 0°K is directly proportional to the strength of the field at the cathode, E, and inversely proportional to the square root of the work function ϕ. For a tungsten cathode with $\phi = 4{\cdot}5$ eV and $E = 3{\cdot}5 \times 10^9$ V/m the equivalent temperature is 2 640°K. A small change in either E or ϕ has a very large effect on the emission.

621.385.032.216 **3583**

Electrolytic Transport Phenomena in the Oxide Cathode.—R. H. Plumlee. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 190–230.) Experiments are described in which chemical changes were detected in BaO cathodes following emission of electrons. The evaporation of H_2, H_2O, O_2, CO and CO_2 from the cathode was found to depend on field strength, temperature, state of cathode activity, lapse of time, and previous duty period. Some correlation was also found between residual gas pressures and cathode activity. It is deduced that the cathode coating contains impurities incorporated as anions in labile equilibrium with their molecular dissociation fragments present in the vacuum at low partial pressures.

621.385.032.216 **3584**

Emission and Conduction Measurements on Oxide Cathodes.—A. Kestelyn-Loebenstein. (*Appl. sci. Res.*, 1956, Vol. B6, Nos. 1/2, pp. 105–116.) An experimental investigation of cathodes with Ni base is reported; the observed characteristics are fundamentally different from those for W-base cathodes (*Le Vide*, July/Sept. 1954, Vol. 9, Nos. 52/53, pp. 148–154). The shape of the characteristics is not consistent with a pore-conduction mechanism, but a second conduction mechanism whose onset depends on field strength is indicated; this is thought to have its seat in the Ni/coating interface.

621.385.032.216 **3585**

Capillary Cathodes produced by Compression and Sintering.—G. Mesnard & R. Uzan. (*Le Vide*, March/April 1956, Vol. 11, No. 62, pp. 44–53.) Cathodes with a porous nickel or tungsten surface, containing mixed Ba and Sr carbonates, are discussed and their performance is compared with that of cathodes in which the alkaline-earth carbonates are mixed homogeneously with nickel or tungsten powder. See also 1842 of 1955 (Uzan & Mesnard).

621.385.032.216 : 537.311.33 **3586**

The Electron Donor Centers in the Oxide Cathode.—R. H. Plumlee. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 231–274.) The chemistry of the oxide cathode, and of electronically active solids in general, is considered in terms of the electronic chemical potential, which is determined by the Fermi level of the material. A particular impurity group is identified as the important donor-centre type. For a brief note on this work, see *J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 659–660.

621.385.15 + 621.383.27] : 621.396.822 **3587**

Flicker Noise in Secondary-Emission Tubes and Multiplier Phototubes.—R. C. Schwantes, H. J. Hannam & A. van der Ziel. (*J. appl. Phys.*, June 1956, Vol. 27, No. 6, pp. 573–577.) Noise measurements on Type-EFP 60 secondary-emission valves and Type-5819 photomultipliers are reported; the existence of a flicker-noise component varying as $1/f$ at frequencies up to 10^4 c/s was established for the valves but not for the photomultipliers. The results are discussed in terms of fluctuations of the work function of the emitting surfaces.

621.385.33.026.446 **3588**

Technology of the 120-kW Transmitting Triode Type-RS 526.—E. Uredat. (*Telefunken Ztg*, March 1956, Vol. 29, No. 111, pp. 47–54. English summary, p. 65.) The construction of this water-cooled triode is described and compared with that of the 80-kW air-cooled triode Type-RS 726 and the 120-kW triode Type-RS 826 cooled by evaporation of water. The characteristics of the three triodes are tabulated.

621.385.5 **3589**

Current Partition in Electron Valves with More than One Positive Electrode, for Low Current Densities.—H. Göllnitz. (*Hochfrequenztech. u. Elektroakust.*, Jan. 1956, Vol. 64, No. 4, pp. 95–102.) Current partition in pentodes is examined by calculating the electron trajectory for the limiting case dividing electrons passing through the suppressor grid from those reflected by it, for an arbitrary angle of incidence of the electrons. The calculation is facilitated by considering only paths through the saddle points of the suppressor-grid field.

621.385.5 : 621.396.621.54 **3590**

The Presentation and Application of the Characteristics of the Pentagrid Converter Valve.—H. R. Wilshire. (*Proc. Instn Radio Engrs, Aust.*, April 1956, Vol. 17, No. 4, pp. 113–122.) "The conversion transconductance (g_c) of pentagrid converter valves (1R5 and 6BE6) is a function of the signal grid bias, direct screen voltage, screen grid oscillator voltage, oscillator grid current and, in some circuits, the oscillator voltage at the cathode. This paper discusses the measurement and display of the variation of g_c with these five parameters with the object of obtaining optimum performance in the converter stage of radio receivers."

621.385.832 **3591**

Theory of Deflection.—A. M. Strashkevich. (*Radiotekhnika, Moscow*, Feb. 1956, Vol. 11, No. 2, pp. 64–69.) The general properties of axially antisymmetric fields which can be used in the deflectron [3290 of 1952 (Schlesinger)] are considered. The condition is derived for equal sensitivity of deflection of an electron beam in two mutually perpendicular directions and an example of a system satisfying this condition is given.

621.385.832 : 535.376.07 **3592**

Variations of the Properties of Luminescent Screens under Electron Bombardment in Cathode-Ray Tubes.—K. H. J. Rottgardt & W. Berthold. (*Z. Naturf.*, Sept./Oct. 1955, Vol. 10a, Nos. 9/10, pp. 736–740.) The luminescence decay curves and the dependence of luminescence intensity on anode voltage are compared for Al-coated ZnS:Ag screens (*a*) before and (*b*) after bombardment by 16-kV electrons. The results indicate that the observed reduction of luminescence is associated with disturbance of the crystal lattice. See also 2485 of 1955.

621.385.832 : 621.397.621.2 : 535.623 **3593**

Kinescope Electron Guns for producing Non-circular Spots.—R. C. Knechtli & W. R. Beam. (*RCA Rev.*, June 1956, Vol. 17, No. 2, pp. 275–296.) Designs are described in which either the electron crossover or an interposed aperture is shaped so as to produce a spot of desired noncircular form. One example is a line-crossover gun suitable for the parallel-line-screen colour kinescope discussed by Bond et al. (848 of 1952).

621.387 : 621.318.57(083.74) **3594**

I.R.E. Standards on Electron Tubes: TR and ATR Tube Definitions, 1956. (*Proc. Inst. Radio Engrs*, Aug. 1956, Vol. 44, No. 8, pp. 1037–1039.) Standard 56 I.R.E. 7. S3.

MISCELLANEOUS

061.4 : 621.37/.39 **3595**

Radio Show Review.—(*Wireless World*, Oct. 1956, Vol. 62, No. 10, pp. 468–480.) Report of design trends observed at the 1956 National Radio Exhibition. Greater standardization of television receivers is noted; transistors are used in portable broadcast receivers and sound-reproducing equipment. Band-III and dual-band aerials were featured. Transistors with cut-off frequencies up to 10 Mc/s were shown. For another account, see *Wireless Engr*, Oct. 1956, Vol. 33, No. 10, pp. 229–234.

061.6 : 621.396 **3596**

Physics at the Radar Research Establishment, Malvern.—R. A. Smith. (*Proc. roy. Soc. A*, 10th April 1956, Vol. 235, No. 1200, pp. 1–10.) An account of the organization and research programme.

621.3 : 378.9 **3597**

B.B.C. Engineering Training Centre.—(*Engineer, Lond.*, 1st June 1956, Vol. 201, No. 5236, pp. 609–610.) A brief description of the organization, equipment and curriculum of the Centre at Wood Norton Hall.

621.3.002.2 : 551.58 **3598**

Consideration of Climatic Influences in the Development and Construction of Electronic Equipment.—E. Ganz & K. Michel. (*Bull. schweiz. elektrotech. Ver.*, 12th May 1956, Vol. 47, No. 10, pp. 441–458. In French.) Factors discussed include temperature, pressure, humidity, icing, air pollution and ultraviolet radiation; both large-scale geographic and local environmental variations are considered. No simple tropicalization process is universally satisfactory; the particular conditions must be studied in each case. Climatological knowledge should be more systematically disseminated.

ABSTRACTS and REFERENCES

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research and published by arrangement with that Department.

The abstracts are classified in accordance with the Universal Decimal Classification. They are arranged within broad subject sections in the order of the U.D.C. numbers, except that notices of book reviews are placed at the ends of the sections. U.D.C. numbers marked with a dagger (†) must be regarded as provisional. The abbreviations of journal titles conform generally with the style of the World List of Scientific Periodicals. An Author and Subject Index to the abstracts is published annually; it includes a selected list of journals abstracted, the abbreviations of their titles and their publishers' addresses.

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ACOUSTICS AND AUDIO FREQUENCIES

534.232 **3599**

Variable Resonant Transducer.—D. H. Robey. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 700–704.) Variation of the resonance frequency of a composite system, such as a crystal plate associated with a backing plate, is effected by applying a force which varies the friction between the two plates.

534.232 : 534.64 **3600**

Transducer Calibration by Impedance Measurements.—G. A. Sabin. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 705–710.)

534.24 **3601**

Reflection of a Plane Acoustic Wave from a Surface of Nonuniform Impedance.—H. S. Heaps. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 666–671.) Theory is presented for surfaces with (*a*) random and (*b*) nonrandom nonuniformity. In case (*a*), the reflection obeys Lambert's cosine law if the surface is at approximately zero pressure; perfectly diffuse scattering is obtained if the surface is approximately rigid. In case (*b*), the scattered radiation is contained in a beam whose axis lies in the direction of specular reflection.

534.24 **3602**

Reflection of Plane Sound Waves from an Irregular Surface.—J. G. Parker. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 672–680.) Analysis is presented in which the reflected field is regarded as formed by superposed plane waves with unequal amplitudes. The method is used to investigate scattering from a surface with sinusoidal corrugations in one dimension. The results are compared with those given by Rayleigh's theory and with measurements made by LaCasce & Tamarkin (1938 of July).

534.413 : 534.115 **3603**

Gaseous and Liquid Jets Sensitive [to sound].—M. Dubois. (*Ann. Télécommun.*, May 1956, Vol. 11, No. 5, pp. 111–116.) Results of measurements on air and water jets are presented graphically to show the frequency ranges over which jets with given diameter and flow velocity are sensitive.

534.414 : 534.833 **3604**

The Degree of Sound Absorption by Cavity Resonators and its Dependence on the Arrangement.—E. Kohlsdorf. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 162–164.) Results of calculations are compared with measurements by the Kundt's tube and reverberation-room methods. Point, line and area distributions of the resonators are considered.

534.612.2 **3605**

Acoustic Wattmeter.—T. J. Schultz. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 693–699.) Equipment is described comprising a small probe containing a pair of microphones with their pre-amplifiers, connected by cable to the unit containing amplifiers, equalizers, phase-shifters and measuring circuits. Direct readings of acoustic intensity are obtained over a 50-dB range at frequencies up to 10 kc/s. Theory and measurement results are given.

534.7 **3606**

Effect of attenuating One Channel of a Dichotic Circuit upon the Word Reception of Dual Messages.—G. C. Tolhurst & R. W. Peters. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 602–605.) Experiments indicate that the improvement in the reception of the unattenuated message is more pronounced with a noisy than with a quiet background.

534.7 : 534.86 **3607**

Articulation Reduction by Combined Distortions of Speech Waves.—D. W. Martin, R. L. Murphy & A. Meyer. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 597–601.) The effects on intelligibility of the following four types of distortion were studied individually and in combination, with different levels of background noise: attenuation of high-frequency components; multiple echo; random amplitude modulation; irregular frequency-response characteristic.

534.7 : 621.39 **3608**

Speech Communication Research Symposium.—(*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 531–591.) The full or summarized text is given of a number of papers presented at the symposium held at San Diego in November 1955. The material was grouped under the headings: Temporal Factors in Speech Reception; Speech Communication in Noise; Speech Analysis and Synthesis Systems.

534.7 : 621.396.822 **3609**

Detection of Signals in Noise: a Comparison between the Human Detector and an Electronic Detector.—C. W. Sherwin, F. Kodman, Jr, J. J. Kovaly, W. C. Prothe & J. Melrose. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 617–622.) Recorded signals mixed with noise were presented to (*a*) four observers and (*b*) a detector system comprising filter with 60-c/s pass band, square-law detector, and integrator. Incomplete correlation between the responses of the observers and the detector can be explained by assuming that the observers' threshold fluctuates about a mean value, or that noise is generated internally within the observers. The false-alarm rate is about an order of magnitude lower for the observers than for the detector system.

534.75 **3610**

Masked Threshold and its Relation to the Duration of the Masked Stimulus.—E. J. Thwing. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 606–610.)

534.75 **3611**

Masking of Tones by Bands of Noise.—R. C. Bilger & I. J. Hirsh. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 623–630.)

534.771 **3612**

Study of Audiometer Standardization.—R. Lehmann. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 466–477.) The determination of the mean threshold of hearing, and measurement techniques for air and bone conduction, are discussed, with a description of progress in various countries in the construction of artificial ears. 39 references.

534.78 : 621.39 **3613**

Bandwidth and Channel Capacity Necessary to transmit the Formant Information of Speech.—J. L. Flanagan. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 592–596.)

534.78 : 621.39 **3614**

The Intelligibility of Amplitude-Limited Speech.—H. Schneider. (*Frequenz*, April & May 1956, Vol. 10, Nos. 4 & 5, pp. 97–106 & 152–161.) Various known limiter systems are compared; the problem of improving signal/noise ratio by amplitude limiting and level regulating, without impairing intelligibility, is discussed. Experimental results indicate that the dynamic range of single tones is at least as significant as the formant structure of the spectrum. A new theoretical explanation is given for the success of the limiting system in which the signal spectrum is pre-distorted and later restored. Systems involving frequency transposition of the speech band are superior as regards freedom from distortion. Separate limiting in sub-bands gives better results again. Intelligibility losses with the less satisfactory systems may amount to 50%, but are only about 10% with the two last-mentioned systems.

534.83/.84 **3615**

Architectural Acoustics.—J. Matras. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 384–415.) A survey covering sources of noise and modes of propagation of sound in buildings, measurement of noise levels, and factors affecting the acoustics of large and small interiors.

534.83 **3616**

Acoustic Insulation of Heavy Structures.—J. Pujolle. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 435–440.) Research on wall materials and methods of construction is carried out in a laboratory consisting of two rooms separated by the test wall. Measurements are reported on some composite structures made of brick and/or cement; the structure selected as satisfactory for insulating studios comprised a three-leaved cement wall with glass wool in the intervening spaces, providing a mean insulation of 94 dB. The importance of avoiding indirect transmission of sound is emphasized.

534.833 : 534.414 **3617**

Coupled Vibrations in [acoustic] **Cavity Resonators with Grids.**—E. Kohlsdorf. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 160–162.) Calculations are made for resonators faced with perforated panels, taking account of resonance of the panel on its own as well as resonance of the whole cavity system. The results are in good agreement with measurements on several systems.

534.833.4 : 621.395.623.54 **3618**

Noise Bands *versus* Pure Tones as Stimuli in measuring the Acoustic Attenuation of Ear Protective Devices.—J. C. Webster, P. O. Thompson & H. R. Beitscher. (*J. acoust. Soc. Amer.*, July 1956, Vol. 28, No. 4, pp. 631–638.)

534.84 : 621.374.32 **3619**

New Acoustic Characterization of Rooms and the Development of a Multipurpose Electronic Counter.—R. Lamoral & R. Trembasky. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 441–449.) The importance of the diffusion characteristics for the acoustic quality of a room is emphasized. An index of diffusion is defined in general terms and apparatus for determining it is described, including details of a specially developed four-decade counter. The index is measured over a range of frequencies up to 4 kc/s as the number of peaks whose value exceeds a given mean level. The apparatus may be used for measuring reverberation time and other acoustic properties.

534.843 **3620**

Sound Level in the Corners and near the Walls of Closed Rooms in the Presence of Noise.—W. Wöhle. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 158–160.) A simple method of calculation is presented; the results are confirmed by measurements on a room of volume 63 m³, using noise bands of 200–400 and 37·5–75 c/s. The greatest difference in sound level between the corners and the middle of the room was about 9 dB.

534.845 **3621**

Visual Display of Sound and Ultrasonic Waves.—F. Canac. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 422–427.) See 2291 of 1954.

534.845 **3622**

The Acoustic Properties of Materials.—T. Vogel. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 428–434.) The analogy between acoustic and electrical phenomena

is used to derive an expression for the coefficient of absorption; a method of determining this coefficient is described, based on measurements of incident and reflected sound fields in a specially constructed chamber (see also 2197 of 1953). Comparison with the original work of Sabine relating acoustic quality with reverberation time shows that Sabine's formula is applicable to conditions involving higher absorption coefficients than are encountered in practice.

534.846 **3623**

Acoustics of the Auditorium at the State Opera House, Berlin, Unter den Linden.—W. Reichardt. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 134–144.) Details are given of tests made in connection with the rebuilding of this opera house; diffusivity, clarity and reverberation time were investigated. Measurements made on models were confirmed by the final results. The reverberation time was made as long as possible, and is longer than that of the building in its previous form.

534.86 : 546.82 **3624**

Application of Metal Titanium to the Acoustic Instruments, in Japan.—T. Hayasaka, K. Masuzawa, S. Nagai & M. Suzuki. (*Rep. elect. Commun. Lab., Japan*, April 1956, Vol. 4, No. 4, pp. 39–54.)

534.86 : 621.396.712.3 **3625**

Modern Broadcasting Studios: Marseilles.—J. Pujolle. (*Onde élect.*, May 1956, Vol. 36, No. 350, pp. 419–421.) A brief description is given of the acoustic treatment of these studios, which include one with a volume of 3 000 m³, having a reverberation time of about 1·5 s, and four smaller studios having reverberation times from 0·5 to 0·8 s.

534.861 : 621.396.813 **3626**

The Receiving Side of a Radio Broadcast Transmission and its Influence on the Audio-Frequency Bandwidth.—Ebert. (See 3881.)

621.395.616 **3627**

Full-Range Electrostatic Loudspeakers.—H. J. Leak & A. B. Sarkar. (*Wireless World*, Oct. 1956, Vol. 62, No. 10, pp. 486–488. Correction, *ibid.*, Nov. 1956, Vol. 62, No. 11, p. 528.) Discussion of a design using two parallel plastic diaphragms, with resistive coatings on the faces turned away from each other, and a parallel conducting electrode fixed midway between them. With this arrangement there is no need for a high resistance in the lead to the charged middle electrode. Other advantages are that the diaphragms need not be unreasonably large, and that they form a dust-proof protection for the middle electrode.

621.395.623.8 **3628**

Experimental Investigation of Sound Coverage of an Open Space by a Distributed System of Loudspeakers.—B. D. Tartakovski. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1956, Vol. 108, No. 4, pp. 636–639. In Russian.) The results indicate that the required coverage can be achieved using 20-W loudspeakers with nondirectional characteristics in the horizontal plane, mounted at a height of 5 m and spaced at about 20 m.

AERIALS AND TRANSMISSION LINES

621.372.029.6 : 621.318.134 **3629**

Waveguide Components with Nonreciprocal Properties.—Brown & Clarricoats. (See 3666.)

621.372.2 + 621.396.677.3] : 512.3 **3630**

Application of Chebyshev [Tchebycheff] **Polynomials in the Calculation of Step Transitions.**—Ya. M. Turover & N. I. Strutinski. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 143–161.) Applications to the theory of transmission lines and aerial arrays are discussed.

621.372.2 : 621.315.212 **3631**

On the Theory of a Coaxial Transmission Line consisting of Elliptic Conductors.—J. Y. Wong. (*Canad. J. Phys.*, April 1956, Vol. 34, No. 4, pp. 354–361.) Analysis using elliptic-cylinder wave functions is presented for a line in which the inner and outer conductors have confocal cross-sections. The theory is applicable to the shielded-strip line and the rectangular coaxial line as special cases.

621.372.21 : 621.3.015.3 **3632**

The Capacitor Discharge on the Infinitely Long Line with Uniform Distribution of Resistance and Capacitance.—F. Böttcher. (*Frequenz*, April 1956, Vol. 10, No. 4, pp. 120–125.) Analysis is presented based on a finite source resistance, corresponding to a finite value of current at the instant when the line is connected to the capacitor. Expressions are derived for the voltage and current at any subsequent instant at any point along the line.

621.372.8 **3633**

Curved Waveguides with Constant Cross-Section.—B. Z. Katsenelenbaum. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 171–185.) Propagation in a waveguide comprising a straight and a curved section is considered theoretically. If the radius of curvature is sufficiently large, the solution for the field can be obtained approximately by considering a series of straight sections in place of the actual curved guide. The coefficients for the modes satisfy a system of ordinary differential equations of the first order.

621.372.8 **3634**

Conditions at the Boundary of Imperfectly Conducting Waveguides.—M. L. De Socio. (*R. C. Accad. naz. Lincei*, April 1956, Vol. 20, No. 4, pp. 469–476.) Analysis is presented; expressions derived are compared with those obtained by Baudoux (3151 of 1955).

621.372.8 **3635**

Transmission Loss due to Resonance of Loosely Coupled Modes in a Multi-mode System.—A. P. King & E. A. Marcatili. (*Bell Syst. tech. J.*, July 1956, Vol. 35, No. 4, pp. 899–906.) "In a multi-mode transmission system the presence of spurious modes which resonate in a closed environment can produce an appreciable loss to the principal mode. The theory for the evaluation and control of this effect under certain conditions has been derived and checked experimentally in the particularly interesting case of a TE_{01} transmission system, where mode conversion to TE_{02}, TE_{03} . . . is produced by tapered junctions between two sizes of waveguide."

621.372.8 : 538.221 : 538.63 **3636**

Polarimetric Study of a Ferrite in the 2 000-Mc/s Frequency Band.—P. Loudette & A. Charru. (*C. R. Acad. Sci., Paris*, 16th July 1956, Vol. 243, No. 3, pp. 251–254.) Measurements were made on a system comprising three ferrite rods arranged along the axis of a circular waveguide. The rotation of the plane of polarization on application of a longitudinal magnetic field H, and the square of the ellipticity, are plotted

(*a*) as functions of H with λ as parameter, and (*b*) as functions of λ with H as parameter. Corresponding points of inflection are noted.

621.396.67 : 537.226 **3637**

Some Investigations on Dielectric Aerials: Part 1.—R. Chatterjee & S. K. Chatterjee. (*J. Indian Inst. Sci.*, Section B, April 1956, Vol. 38, No. 2, pp. 93–103.) The radiation field intensity at a distant point due to a circular-section dielectric rod aerial excited in the HE_{11} mode is derived theoretically. General expressions are given for the radiation patterns in two planes of particular interest, and are evaluated for a polystyrene rod of length 3 λ and diameter 0·46 λ.

621.396.67 : 621.396.822 **3638**

Induced Thermal Noise in Aerials.—M. L. Levin. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2313–2318.) Induced fluctuation currents in a thin aerial due to external heated bodies are discussed. Considerable mathematical difficulties arise in the calculation of these currents, owing to the fact that the fluctuation field is not δ-correlated along the aerial. These difficulties are largely avoided by use of the electrodynamic theory of reciprocity. The general formulae so obtained are applied to the following two cases: (*a*) aerial in an equilibrium radiation field; (*b*) thermal noise induced by remote bodies.

621.396.67.029.62 : 621.397.7 **3639**

The Crystal Palace Television Transmitting Station.—McLean, Thomas & Rowden. (See 3895.)

621.396.674.3 **3640**

Some Comments on Wide-Band and Folded Aerials.—E. O. Willoughby. (*J. Brit. Instn Radio Engrs*, Aug. 1956, Vol. 16, No. 8, pp. 455–462.) Reprint. See 2622 of September.

621.396.677 : 621.397.26 **3641**

Deviating Aerial Installations for Television Coverage.—H. Hesselbach. (*Frequenz*, April 1956, Vol. 10, No. 4, pp. 116–120.) Aerial systems for ensuring reception in obscured or marginal areas are discussed; they are termed active or passive according as they are or are not associated with amplifiers; the passive class includes both simple reflectors and systems with separate receiving and transmitting aerials.

621.396.677.012.12 **3642**

End-Fire Arrays of Magnetic Line Sources mounted on a Conducting Half-Plane.—R. A. Hurd. (*Canad. J. Phys.*, April 1956, Vol. 34, No. 4, pp. 370–377.) Expressions are derived for the radiation patterns of arrays of sources such as slots in a perfectly conducting half-plane. The problem is made two-dimensional by assuming the sources to run parallel to the edge of the plane. The variation of beam tilt, beam width and side-lobe level with the array parameters is studied. The theory gives a reasonable representation of the behaviour of corrugated surface radiators embedded in a finite ground plane, provided the distance from the array to the edge is about equal to the array length.

621.396.677.029.6.012.12 **3643**

Microwave Aerial Testing at Reduced Ranges.—D. K. Cheng. (*Wireless Engr*, Oct. 1956, Vol. 33, No. 10, pp. 234–237.) Three methods are presented for determining the appropriate amount of defocus of the primary source for simulating Fraunhofer patterns within the Fresnel zone. The results are plotted and compared.

621.396.677.3 : 523.7 **3644**

The Multiple-Aerial Interferometer at the Nançay Station.—É. J. Blum, A. Boischot & M. Ginat. (*C. R. Acad. Sci., Paris*, 2nd July 1956, Vol. 243, No. 1, pp. 19–22.) A system for locating centres of solar r.f. radiation comprises eight parabolic mirrors of 5 m diameter on an east-west base of length 700 m; it operates on 169 Mc/s and has a resolving power of 7·5′. Some records of the passage of r.f. sources are reproduced. A system of 32 aerials on a 1 500-m base is projected, which is to include the present system.

621.396.677.3.012.12 **3645**

Aerial Pattern Synthesis.—H. E. Salzer. (*Wireless Engr*, Oct. 1956, Vol. 33, No. 10, pp. 240–244.) When the Dolph-Tchebycheff distributions are used to determine the feeding coefficients required to produce sharp beams with broadside arrays, the numerical work increases with the number of sources. An alternative method is described which uses a special case of a general formula due to Poisson to synthesize extremely sharp patterns. A simple explicit expression is derived for the amplitude of the feeding coefficients which is just as easy to calculate for a large number of terms as for a small number.

621.396.677.83 **3646**

Theory of Periscopic Aerial Systems.—L. B. Tartakovski & A. M. Pokras. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 186–196.) A system comprising a parabolic radiator and a plane elliptical deflector is investigated theoretically by a method similar to that used previously by Jakes (1243 of 1953). The solution for the field gain η_E of the system is obtained in terms of infinite series of Bessel functions; the expression is considerably simplified in the cases of (*a*) a point source, and (*b*) uniform distribution of amplitudes over the aperture and coincidence of the radiator aperture with the circular projection of the deflector. η_E is plotted as a function of a dimensionless parameter m for three different amplitude distributions over the aperture and five different ratios of the diameter of the radiator aperture to that of the deflector projection; the effect of the amplitude distribution is shown to be small. The results obtained are in good agreement with those calculated by Jakes and the experimental results of Drexler (2565 of 1954).

621.396.677.83 **3647**

Aerial System with [raised] **Reflector.**—V. D. Kuznetsov. (*Radiotekhnika, Moscow*, March 1956, Vol. 11, No. 3, pp. 4–15.) The radiation characteristics of various arrangements of the type used at microwave relay stations, comprising a reflector-type aerial and a raised deflecting reflector, are considered theoretically.

621.396.677.833 **3648**

The Electromagnetic Field of a Dipole Radiator located inside a Paraboloidal Reflector.—I. P. Skal'skaya. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2371–2380.) The case of a dipole arranged perpendicular to the axis of the paraboloid is considered. The solution given by Pinney (2687 of 1947) in the form of series of Laguerre polynomials is not justified mathematically. A new solution applicable to the whole region inside the paraboloid is obtained which gives the desired field components in the form of complex integrals. This solution is used to determine the field in the limiting case when the wavelength is much smaller than the focal length of the paraboloid.

621.396.677.833 : 523.16 **3649**

The George R. Agassiz Radio Telescope of Harvard Observatory.—Bok. (See 3715.)

621.396.677.833.1 **3650**

Electromagnetic Field of a Linear Radiator located inside an Ideally Conducting Parabolic Screen [reflector].—G. A. Grinberg, N. N. Lebedev, I. P. Skal'skaya & Ya S. Uflyand. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 528–543.) The field problem considered earlier (2867 of 1954) is re-examined and a more rigorous solution is derived. This is shown to agree with the geometrical-optics solution at frequencies tending to infinity.

621.396.677.833.2 **3651**

The Far Field of a Paraboloid of Revolution with Hertzian Dipole Normal to the Plane of the Aperture.—F. Müller. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 155–158.) Calculations show that the power density and field direction are rotationally symmetrical about the axis of the paraboloid; the transverse electric field has zero intensity on the axis.

621.396.677.85 : 621.372.43 **3652**

Reflection and Transmission at a Slotted Dielectric Interface.—R. E. Collin. (*Canad. J. Phys.*, April 1956, Vol. 34, No. 4, pp. 398–411.) Theory presented by Collin & Brown (2293 of August) is extended to the problem of matching a microwave lens to free space for waves incident obliquely. Calculations show that the reflection coefficient can be reduced from 23% to 5% for angles of incidence up to 30°, for waves of 3–3·28 cm λ, the dielectric constant of the slotted medium being 2·56.

AUTOMATIC COMPUTERS

681.142 **3653**

Trends in Computer Input/Output Devices.—J. M. Carroll. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 142–149.)

681.142 **3654**

Design of Computer Circuits for Reliability.—W. Renwick. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 380–384.) Factors influencing the choice of components, and precautions taken during the initial circuit design and mechanical construction of the EDSAC II machine are described.

681.142 **3655**

A Circuit for Analogue Formation of xy/Z.—M. J. Somerville. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 388–389.) "A quarter squares multiplier, using a triangle carrier waveform in the squaring circuits is extended to give division simultaneously with multiplication. This is achieved by controlling the slope of the triangle carrier waveform so as to be proportional to the divisor Z."

681.142 : 621.317.729.1 **3656**

An Automatic Electron Trajectory Tracer.—Pizer, Yates & Sander. (See 3833.)

681.142(083.7) **3657**

I.R.E. Standards on Electronic Computers: Definitions of Terms, 1956.—(*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1166–1173.) Standard 56. I.R.E. 8.S1.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.002.2 **3658**

High-Temperature Components.—G. W. A. Dummer. (*Wireless World*, Oct. 1956, Vol. 62, No. 10, pp. 510–512.) New materials and methods of production to meet Service demands are briefly described.

621.3.049.75 **3659**

Printed Circuits.—(See 3902.)

621.318.4.045 **3660**

Winding Method for Coils with Parallel Windings.—P. von Belatini. (*Bull. tech. Univ. Istanbul*, 1956, Vol. 9, pp. 10–21. In German.) Theory is presented indicating the purposes for which parallel-wound coils are suited, and practical examples are described.

621.318.57 : 621.314.7 **3661**

***P-N-P-N* Transistor Switches.**—Moll, Tanenbaum, Goldey & Holonyak. (See 3899.)

621.318.57 : 621.385 **3662**

Ten-Channel Time-Division Multiplexer.—H. Moss & S. Kuchinsky. (*Tele-Tech & Electronic Ind.*, May 1956, Vol. 15, No. 5, pp. 80–82 . . 154.) A 'magnetron' beam-switching tube [3434 of 1955 (Fan)] forms the basis of a 10-contact, single-channel circuit giving switching times of about 0·2 μs. The tube is used in conjunction with a gating system; a gate circuit is described which permits the examination of signals in the microvolt range.

621.319.4 : 621.373.4 **3663**

Nonlinear D.C.-Tuned Capacitors.—T. W. Butler, Jr, H. Diamond & L. W. Carr. (*Tele-Tech & Electronic Ind.*, May 1956, Vol. 15, No. 5, pp. 68–69 . . 135.) The design and production of very small tuning capacitors using Ba-Sr titanate ferroelectric dielectrics is described. Examples are given of applications to oscillators for the frequency range 25–400 Mc/s, with c.w. power outputs of 50 mW–3 W.

621.372.011.1 **3664**

Formulae relating some Equivalent Networks.—R. J. Duffin & E. Keitzer. (*J. Math. Phys.*, April 1956, Vol. 35, No. 1, pp. 72–82.) Explicit formulae are obtained for the elements of a network without transformers which has the same driving-point impedance as an arbitrary two-loop passive network.

621.372.011.2 **3665**

An Existence Theorem for Driving-Point Impedance Functions.—N. DeClaris. (*J. Math. Phys.*, April 1956, Vol. 35, No. 1, pp. 83–88.)

621.372.029.6 : 621.318.134 **3666**

Waveguide Components with Nonreciprocal Properties.—J. Brown & P. J. B. Clarricoats. (*Electronic Engng*, Aug. & Sept. 1956, Vol. 28, Nos. 342 & 343, pp. 328–332 & 376–379.) The mechanism of the nonreciprocal effects occurring when an e.m. wave is propagated through a magnetized material, particularly a ferrite, is discussed; the gyrator, the isolator and the circulator are described.

621.372.029.64 : 538.569.4 **3667**

Further Aspects of the Theory of the Maser.—Shimoda, Wang & Townes. (See 3710.)

621.372.412 **3668**

Variation of the Quality Factor of Piezoelectric Crystals as a Function of Pressure.—H. Mayer. (*C. R. Acad. Sci., Paris*, 16th July 1956, Vol. 243, No. 3, pp. 246–249.) Measurements were made on a 100-kc/s quartz crystal and on a Rochelle-salt crystal, using apparatus described in *J. Phys. Radium*, June 1956, Vol. 17, Supplement to No. 6, *Phys. appl.*, pp. 104A–107A. Results are presented as $Q/\log p$ curves for values of $\log p$ up to 4, where p is in mm Hg. Decrease of pressure below about 10^{-2} mm Hg does not affect Q value.

621.372.413 **3669**

Design of a Toroidal Cavity Resonator by the Method of Curvilinear Coordinates.—V. L. Patrushev. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 162–170.) The application of the formulae derived is illustrated by a calculation of the resonance frequency of a cavity of given dimensions. The calculated value of $\lambda = 23{\cdot}0$ cm agrees well with the experimental value of 23·2 cm.

621.372.5 **3670**

Restrictions on the Shape Factors of the Step Response of Positive Real System Functions.—A. H. Zemanian. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1160–1165.) Extension of previous analysis of the transient response of networks (1577 of 1955).

621.372.5 : 537.227 **3671**

Theory of Nonlinear Coupling in a Novel Ferroelectric Device.—W. H. Higa. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 775–777.) A device which can be used as a modulator or as a frequency divider or multiplier comprises a block of ferroelectric material with electrodes arranged on two pairs of facing sides. On connecting an inductance across one pair of electrodes, a resonant circuit is provided in which the capacitance varies periodically, oscillations being sustained when the frequency of this parametric excitation is twice the resonance frequency of the circuit. Analysis is presented using the Mathieu equation.

621.372.54 **3672**

The Analysis of Three-Terminal Null Networks.—T. H. O'Dell. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 398–400.) A simple method of analysis is presented; the twin-T and bridged-T networks are treated as examples.

621.372.54 **3673**

By-Pass Filters.—R. O. Rowlands. (*Wireless Engr*, Oct. 1956, Vol. 33, No. 10, pp. 238–240.) "By-pass filters are described having three pairs of terminals and in which all frequencies are passed, without distortion, between two of the pairs but only a limited band of frequencies is transmitted between either of these pairs and the third pair of terminals."

621.372.543.3 **3674**

An Improved Crystal Band-Elimination Filter.—R. C. Leigh. (*A.T.E. J.*, April 1956, Vol. 12, No. 2, pp. 101–106.) An all-pass network consisting of two filters in parallel is described, suitable for applications in which it is required to transmit a wide frequency range while suppressing one or more narrow frequency bands within the range. Internal impedance transformations eliminate the need for high-ratio transformers.

621.372.56.029.6 : 621.372.8 : 621.318.134 **3675**

The Field Displacement Isolator.—S. Weisbaum & H. Seidel. (*Bell Syst. tech. J.*, July 1956, Vol. 35, No. 4, pp. 877–898.) A nonreciprocal device with forward loss about 0·2 dB and reverse loss about 30 dB over a wide band at about 6 kMc/s is based on use of a single ferrite slab spaced from the wall of a rectangular waveguide and having a resistive strip on one face. Optimum field conditions in the waveguide are discussed.

621.372.57 : 621.374.34 **3676**

Operation of an Amplitude Limiter.—M. E. Zhabotinski & Yu. L. Sverdlov. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 205–212.) Theoretical analysis and experimental evidence suggest that the stray capacitance shunting the nonlinear element causes a parasitic phase modulation of the output signal and limits the efficiency. A neutralized circuit is shown and design formulae are given.

621.372.632 : 621.314.63 **3677**

Two-Terminal *P-N* Junction Devices for Frequency Conversion and Computation.—Uhlir. (See 3897.)

621.373.421.1 **3678**

Mutual Synchronization of Three Coupled Oscillators with Weak Couplings.—V. N. Parygin. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 197–204.) The system investigated theoretically and experimentally comprises three triode valve oscillators coupled by small capacitors between the grids of the first and second and second and third valves. Approximate expressions are derived for the frequency and amplitude of the oscillations in each oscillator. The regions where mutual synchronization takes place are shown in a Δ_2/Δ_1 graph, where Δ_1 and Δ_2 are respectively the frequency differences between the first and second and the third and second oscillators.

621.373.421.13 : 621.396.96 **3679**

Stable Local Oscillator for S-Band Radar.—W. J. Dauksher. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 179–181.) A continuous frequency range of 1·3% is obtained using six crystal oscillators tunable over overlapping ranges of 0·25%. The desired output frequency is obtained by means of harmonic amplifiers.

621.374.3 **3680**

A Possible Construction of Amplitude Analysers.—A. M. Bonch-Bruevich. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2397–2398.) A circuit is described by means of which pulses with amplitudes exceeding or lying within certain limits can be counted.

621.374.3 : 621.396.822 **3681**

Influence of Large Fluctuations on an Electronic Relay.—V. I. Tikhonov. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 213–224.) The probability of untimely triggering by fluctuation voltages is considered theoretically. The cases discussed include the effect of fluctuations on a relay with or without inertia both in the presence and in the absence of regular pulses; the effect on a coincidence-type circuit is also discussed.

621.375.13 **3682**

Effect of Component Tolerances in Low-Frequency Selective Amplifiers: some Experimental Results.—N. S. Nagaraja & V. Rajaraman. (*J. Indian Inst. Sci.*, Section B, April 1956, Vol. 38, No. 2, pp. 81–92.) Results obtained previously by analysis [1339 of May (Nagaraja)] have been verified experimentally, using the operational amplifiers of the PREDA analogue computer [24 of January (Biswas et al.)].

621.375.232.3 : 621.3.018.75 **3683**

Trailing Edge of Pulse in Cathode Follower with Capacitive Load.—M. L. Volin. (*Radiotekhnika, Moscow*, March 1956, Vol. 11, No. 3, pp. 63–69.) The decay time of a rectangular pulse at the output of a cathode follower can be shortened by connecting a triode in parallel with the cathode resistor and capacitor and controlling the triode grid voltage via a *RC* coupling from the anode of the cathode-follower tetrode valve. The circuit constants are such that the triode impedance decreases momentarily at the end of each pulse.

621.375.4 : 621.314.7 **3684**

The Design of Tetrode Transistor Amplifiers.—J. G. Linvill & L. G. Schimpf. (*Bell Syst. tech. J.*, July 1956, Vol. 35, No. 4, pp. 813–840.) Methods are discussed for determining suitable loads when the two-port parameters of the transistor are known. Charts are presented for determining power gain and input impedance as functions of load. Circuits described as examples include a common-base 20-Mc/s video amplifier, a common-emitter 10-Mc/s video amplifier, and i.f. amplifiers centred at 30 Mc/s and 70 Mc/s respectively. Predicted and measured gains are compared.

621.375.4 : 621.314.7 **3685**

Servo Amplifiers use Power Transistors.—B. M. Benton. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 153–155.) High efficiency in a class-B-type amplifier using Ge power transistors is obtained by providing the collector power by full-wave rectification of the a.c. power supply.

621.375.4 : 621.314.7 : 546.28 **3686**

Micro-power Operation of Silicon Transistors.—Keonjian. (See 3898.)

GENERAL PHYSICS

535.33-1 : 535.417 : 538.569.4 **3687**

Interferometric Spectroscopy in the Far Infra-red.—H. A. Gebbie & G. A. Vanasse. (*Nature, Lond.*, 25th Aug. 1956, Vol. 178, No. 4530, p. 432.) The response of a thermal detector to the resultant of two interfering infrared beams was measured using a reflection interferometer with the path difference varied up to 7 mm. The spectral information is displayed in a Fourier transform obtained by analysis of the resultant-intensity/path-difference curve. An instrument with 30-cm aperture has been made for studying atmospheric transmission at submillimetre wavelengths.

537.2 **3688**

An Extension of the Circle and Sphere Theorems.—G. Power. (*Brit. J. appl. Phys.*, June 1956, Vol. 7, No. 6, pp. 218–221.) Theory relating to cylinders and spheres immersed in two- and three-dimensional electric fields (e.g. 3555 of 1955) is extended to include certain other boundaries along which either the electric potential or the current function takes a constant value.

537.311.1 **3689**

On the Bohm-Pines Theory of a Quantum-Mechanical Electron Plasma.—C. G. Kuper. (*Proc. phys. Soc.*, 1st June 1956, Vol. 69, No. 438A, pp. 492–495.) Analysis indicates that as a result of neglecting certain conditions discussed by Adams (3219 of 1955), the Bohm-Pines theory (1375 of 1954 and back references) may give incorrect results.

537.311.31 + 537.533 **3690**

Concerning the Papers by S. E. Khaikin, S. V. Lebedev, and L. N. Borodovskaya [on effects of high current densities] **published in *Zh. eksp. teor. Fiz.* in 1954–1955.**—I. F. Kvartskhava. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 621–623.) Criticism of papers abstracted e.g. in 2992 of 1955 and back references.

537.311.31 **3691**

Integrals of Interest in Metallic Conductivity.—D. K. C. MacDonald & L. T. Towle. (*Canad. J. Phys.*, April 1956, Vol. 34, No. 4, pp. 418–419.)

537.5 : 538.56 **3692**

Oscillations and Fluctuations in Gas Discharges.—K. G. Emeleus. (*Nuovo Cim.*, 1956, Vol. 3, Supplement, No. 3, pp. 490–495. In English.) A tentative classification is made of different forms of disturbance encountered in gaseous conductors constituted by low-pressure tubes. A distinction is drawn between (*a*) cases where the gaseous conductor acts as a circuit unit possessing resistance, capacitance and inductance, any of which may be positive or negative, and (*b*) cases where internal disturbances occur in the gaseous conductor which are practically independent of the external circuit. The origin and nature of electron and ion oscillations is discussed.

537.52 : 538.56.029.6 **3693**

Electrical Breakdown in Argon at Ultra-high Frequencies.—A. D. MacDonald & J. H. Matthews.—(*Canad. J. Phys.*, April 1956, Vol. 34, No. 4, pp. 395–397.) Report of measurements made using resonant cavities at a frequency of 2·8 kMc/s, with pressures ranging from 4×10^{-2} to 200 mm Hg.

537.533 **3694**

Thermionic Emission, Field Emission, and the Transition Region.—E. L. Murphy & R. H. Good, Jr. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1464–1473.) The combined thermionic and field emission from a metal is studied as a whole; a general expression is derived in the form of a definite integral, relating the emission current to the field, the temperature and the work function. Modified forms of the Richardson-Schottky and Fowler-Nordheim formulae are shown to be respectively valid over limited regions of low field and high temperature on the one hand and low temperatures and high field on the other. An expression is also derived for the emission current in the transition region.

537.533.8 : 537.226 **3695**

Secondary Electron Emission from Single Crystals of Alkali Halide Compounds.—A. R. Shul'man & B. P. Dement'ev. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2256–2263.) Experiments were carried out which show that the dielectrics investigated differ from metals in respect of the dependence of the coefficient of secondary emission on the energy of the primary electrons and also in respect of the secondary-electron energies, which in this case are approximately uniform.

538.114 **3696**

Thermodynamic Behavior of an Ideal Ferromagnet.—F. J. Dyson. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1230–1244.) The free energy of an ideal ferromagnetic lattice is evaluated as a series expansion in powers of the temperature. A mathematical formulation for calculating the effect of spin-wave interactions is developed in a separate paper (*ibid.*, pp. 1217–1230).

538.244.2 **3697**

The Magnetization of a Cylinder by means of a Coil, taking Account of Magnetic Viscosity.—A. N. Tikhonov & A. A. Samarski. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2319–2328.) The problem of the magnetization of a conducting cylinder in a magnetic field, when the value of the field is abruptly changed, was solved in a general form by Vvedenski (*J. Soc. phys.-chim. russe*, 1923, Vol. 55, p. 1). A solution is now given for the case when magnetic after-effects are present. The results are used for determining the coefficients of magnetic permeability and viscosity, and the retarding action of the coil is taken into account by a corresponding change in the boundary condition on the cylinder surface.

538.3 **3698**

The Determination of the Electromagnetic Field inside a Homogeneous and Isotropic Conductor.—A. Tonolo. (*R. C. Accad. naz. Lincei*, April & May 1956, Vol. 20, Nos. 4 & 5, pp. 403–408 & 556–560.) A new method of integrating Maxwell's equations is presented.

538.3 **3699**

Field of a Uniformly Charged Disk and Magnetic Field of a Thin [single-layer] **Circular-Cylinder Coil with Contiguous Turns traversed by a Direct Current.**—R. Cazenave. (*Rev. gén. Élect.*, May 1956, Vol. 65, No. 5, pp. 301–310.) The field of the uniformly charged disk is used to study that of the coil, by virtue of the magnetic equivalence between the coil and a magnet of the same shape with opposite magnetic poles on the two end faces. Formulae for mutual and self inductance are hence derived.

538.561 : 537.122 **3700**

Electrodynamics of Moving Media and the Theory of the Čerenkov Effect.—B. D. Nag & A. M. Sayied. (*Proc. roy. Soc. A*, 12th June 1956, Vol. 235, No. 1203, pp. 544–551.) "The generalized Frank & Tamm's formula for the total energy radiated as Čerenkov radiation by a swiftly moving charged particle in a medium of dielectric constant ϵ and permeability μ has been derived employing the invariance of the phenomenological electrodynamic equations of Maxwell. The scheme is self-consistent, and the idea of the indetectability of the ether wind is contained in it. It is found that the Čerenkov radiation is μ times larger than that predicted by the Frank & Tamm's formula for $\mu = 1$. Experiments are suggested to detect strong Čerenkov radiation in highly permeable mediums."

538.561 : 621.373.029.65/.66 **3701**

Pulsed Coherent Generation of Millimetre Waves by Nonrelativistic Electron Bunches.—G. A. Askar'yan. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 584–586.) The production of microwaves by bunched electron beams incident on metallic or dielectric anticathodes or by interaction with strong localized fields is briefly discussed and energy relations are stated.

538.566 **3702**

The Effect of the Surface Curvature of a Convex Metal Body on the Radiation from a Source on its Surface.—M. L. Levin. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2395–2396.) The radiation is usually calculated from 'reflection' formulae derived by replacing the convex surface by a plane. The magnitude of the error thus introduced is estimated.

538.566 : 535.42] + 534.26 **3703**

The Diffraction of a Cylindrical Pulse by a Half-Plane.—R. D. Turner. (*Quart. appl. Math.*, April 1956, Vol. 14, No. 1, pp. 63–73.) A method of analysis is used which enables the Green's function to be derived. Two transformations and two inversions are involved.

538.566 : 535.42 **3704**

Diffraction Pattern in the Plane of a Half-Screen.—L. R. Lewis. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 837–838.) Measurements are briefly reported for the case of plane-polarized radiation incident normally on a half-plane and polarized parallel to the diffracting edge. The results are discussed in relation to a formula derived by Andrews (3141 of 1950) and the observations of Harden (88 of 1953).

538.566 : 535.42 **3705**

Integro-differential Equations and Babinet's Principle for Plane Screens with Directional Conductivity.—G. Toraldo di Francia. (*R. C. Accad. naz. Lincei*, April 1956, Vol. 20, No. 4, pp. 476–480.) Analysis is presented for diffraction by screens formed e.g. of parallel conducting wires. Four cases are distinguished: (*a*) a finite parallel-wire screen alone; (*b*) a finite parallel-wire screen surrounded by an infinite nondirectionally conducting screen; (*c*) a finite aperture surrounded by an infinite parallel-wire screen; (*d*) a finite nondirectionally conducting screen surrounded by an infinite parallel-wire screen. Cases (*a*) and (*b*) are complementary in the sense of Babinet's principle; so also are cases (*c*) and (*d*). There is no special relation between cases (*a*) and (*c*) or (*b*) and (*d*).

538.566 : 537.56 **3706**

Electromagnetic Radiation from Electron Plasma.—S. Hayakawa & N. Hokkyo. (*Progr. theor. Phys.*, March 1956, Vol. 15, No. 3, pp. 193–202.) Theory developed by Bohm & Pines (1375 of 1954 and back references) is extended to treat the coupling between longitudinal and transverse plasma oscillations, arising from the quantum fluctuation of electrons interacting with the e.m. field. The theory may provide the explanation of the outbursts of solar r.f. emission.

538.566 : 539.13 **3707**

Molecular Ringing.—S. Bloom. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 785–788.) "Semiclassical radiation theory is used to describe the response of an assemblage of two-state molecules driven by an electromagnetic field. When the field is suddenly removed, the assemblage does not immediately become quiescent; it continues to radiate in diminishing amount. This coherent molecular-ringing radiation persists until the molecular populations return to the values they had at the beginning of the driving pulse. Depending upon the strength and duration of the driving pulse, the ringing radiation may exhibit a delayed peak."

538.566 : 621.372.8 **3708**

Radiation of Electromagnetic Waves during the Uniform Motion of Electric Charges near an Inhomogeneity.—V. B. Braginski. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 225–232.) The radiation occurring in a nonuniform waveguide in which a given convection current is flowing and the transient radiation due to the passage of finite bunches of charge through ideally conducting grids are considered theoretically using the methods of perturbation theory.

538.569.4 : 621.372.029.64 **3709**

Theory of Molecular [-beam] **Oscillator and Molecular** [-beam] **Power Amplifier.**—N. G. Basov & A. M. Prokhorov. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 560–563.) See 2931 of 1955.

538.569.4 : 621.372.029.64 **3710**

Further Aspects of the Theory of the Maser.—K. Shimoda, T. C. Wang & C. H. Townes. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1308–1321.) Problems relating to saturation effects and cavity-resonator design for the device discussed previously [e.g. 403 of February (Gordon et al.)] are examined; various types of noise and oscillator frequency shift are considered. The theoretical minimum detectable beam intensity when the maser is used as a spectrometer for the 3–3 ammonia line is about 10^9 molecules/sec under typical experimental conditions.

621.318.3 **3711**

A General-Purpose Electromagnet.—W. Sucksmith & S. P. Anderson. (*J. sci. Instrum.*, June 1956, Vol. 33, No. 6, pp. 234–236.) Details are given of a magnet for laboratory purposes, with a soft iron yoke having low residual magnetism and poles of diameter 10 cm, together with a table showing the variation of the field in the centre of the gap with excitation and gap length.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.16 **3712**

Distribution of Radio Stars.—J. G. Bolton. (*Observatory*, April 1956, Vol. 76, No. 891, pp. 62–64.) A tentative explanation is given of discrepancies between the distribution derived by Ryle from interferometer measurements at 81 Mc/s and that derived by Pawsey from Mills Cross measurements, also at 81 Mc/s, as discussed at the recent Jodrell Bank symposium.

523.16 **3713**

The Radio Source near the Galactic Centre.—B. Y. Mills. (*Observatory*, April 1956, Vol. 76, No. 891, pp. 65–67.) Recent observations on 3·5 m λ with the 'cross' aerial are discussed in relation to earlier observations on 9·4 cm and 21 cm λ. The position of the dominant source is shown on a contour map of equivalent brightness temperatures. Alternative models accounting for the observations and involving absorbing H II regions are mentioned; whichever model is assumed, the nucleus of Type-II stars in the Galaxy is not itself detectable as a r.f. source.

523.16 **3714**

Polarization Measurements on Three Intense Radio Sources.—R. H. Brown, H. P. Palmer & A. R. Thompson. (*Mon. Not. R. astr. Soc.*, 1955, Vol. 115, No. 5, pp. 487–492.) Measurements have been made on radiation of wavelength 1·9 m from sources in Cygnus, Cassiopeia and Taurus. The results indicate that there is no plane polarized component $> 1\%$ and no circularly polarized component $> 4\%$ in the flux from the first two of these sources; the corresponding figures for the source in Taurus are $2\frac{1}{2}\%$ and 4% respectively.

523.16 : 621.396.677.833 **3715**

The George R. Agassiz Radio Telescope of Harvard Observatory.—B. J. Bok. (*Nature Lond.*, 4th Aug. 1956, Vol. 178, No. 4527, pp. 232–234.) The aerial of this 60-ft instrument is a paraboloid of expanded aluminium-wire mesh with a horn collector at the focus. At a wavelength of 21 cm the angular resolution is about 0·7°, thus the accuracy of setting and following is more than sufficient for research on discrete radio sources. The receiver is a double-conversion superheterodyne comparison radiometer with a 20-channel comb filter at the second conversion frequency. The instrument is to be used both for research and training.

523.5 **3716**

Some Factors affecting the Radio Determination of Meteoric Velocities.—D. W. R. McKinley. (*Naturwissenschaften*, May 1956, Vol. 43, No. 10, pp. 221–222. In English.) Questions raised by Hoffmeister (409 of February) are discussed further. Deceleration of meteors along the path prior to the point of measurement may be an important factor; techniques for measuring the deceleration over an appreciable path length by the radio amplitude/time method require to be developed. Existing techniques may be failing to detect faint meteors with hyperbolic orbits.

523.5 : 621.396.96 **3717**

Radar Echoes from Meteor Trails under Conditions of Severe Diffusion.—G. S. Hawkins. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, p. 1192.) An expression is derived indicating that the power of the echo is proportional to λ^6 and to R^{-4}, where R is the range. For a given meteor velocity there is a critical height above which the effects of diffusion become serious. A graph shows the critical-height/velocity curves for values of λ between 0·5 and 16 m.

523.7 : 621.396.677.3 **3718**

The Multiple-Aerial Interferometer at the Nançay Station.—Blum, Boischot & Ginat. (See 3644.)

523.72 : 523.78 **3719**

Radio-Frequency Observations of the Solar Eclipse of June 30, 1954.—G. Eriksen, O. Hauge & E. Tandberg-Hanssen. (*Astrophys. norveg.*, Aug. 1955, Vol. 5, No. 4, pp. 131–152.) "Radio-frequency power received from the sun at wavelengths of 60 cm and 1·5 m was measured during the solar eclipse of June 30, 1954. The sun was essentially free from active areas, and the eclipse curves obtained have been used to derive models of the radio sun at the two wavelengths. These models give predicted eclipse curves in good agreement with the observed ones. Comparison has been made with models derived by other investigators on the same wavelengths."

523.746 **3720**

The Constancy of the Scale of the Relative Sunspot Numbers.—W. Gleissberg. (*Naturwissenschaften*, May 1956, Vol. 43, No. 9, p. 196.) Comparison of sunspot numbers with the Greenwich data for sunspot areas over several cycles indicates that the proportionality factor between total sunspot area and relative sunspot number increases with the latter, but there is no significant variation of the scale of the relative sunspot number.

550.38 : 523.165 **3721**

Effective Geomagnetic Equator for Cosmic Radiation.—J. A. Simpson, K. B. Fenton, J. Katzman & D. C. Rose. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1648–1653.) The distribution of the geomagnetic field extending far from the surface of the earth is investigated by using cosmic-ray particles as probes. Measurements using the neutron intensity from the nucleonic component indicate wide discrepancies between the observations and geomagnetic coordinates derived from surface magnetic-field measurements. Some anomalous observations of cosmic rays can be explained as due to the interaction of the rotating and inclined magnetic dipole field with a highly ionized interplanetary medium. See also 2371 of August (Simpson et al.).

550.385.523.78 **3722**

Theory of Solar-Eclipse Effects on the Earth's Magnetic Field.—H. Volland. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 131–143. In German.) "The deformation of the S_q current during a solar eclipse is represented by a current function S_e, which is superposed on the S_q system and moves with the eclipse. The magnetic field components of S_e are computed, and the influence of the part induced in the earth's crust is discussed."

551.5 **3723**

Upper-Air Density and Temperature by the Falling-Sphere Method.—F. L. Bartman, L. W. Chaney, L. M. Jones & V. C. Liu. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 706–712.) Technique and

results are described of a method for investigating the atmosphere at heights up to 100 km. A 4-ft nylon sphere with a transponder and aerial is ejected from a rocket near the peak of its trajectory.

551.510.5 : 621.396.11 **3724**

Turbulent-Mixing Theory applied to Radio Scattering.—Silverman. (See 3853.)

551.510.534 **3725**

An Experimental Investigation of the 9·6-μ Band of Ozone in the Solar Spectrum.—C. D. Walshaw & R. M. Goody. (*Quart. J. R. met. Soc.*, April 1956, Vol. 82, No. 352, pp. 177–186.) Mean heights of atmospheric ozone have been investigated over a period of two years, using Strong's method (1297 of 1941). A seasonal variation is observed, with a minimum height in summer and a range of 3·4 km.

551.510.534 **3726**

Determination of the Vertical Distribution of Ozone from Emission Spectra.—R. M. Goody & W. T. Roach. (*Quart. J. R. met. Soc.*, April 1956, Vol. 82, No. 352, pp. 217–221.)

551.510.535 **3727**

Electron Density in a Nonisothermal Ionosphere.—F. Mariani. (*Ann. Geofis.*, Jan. 1956, Vol. 9, No. 1, pp. 43–62.) Continuation of work noted previously (749 of March). The difference in the calculated values of electron density when the earth's curvature is taken into account may be appreciable, especially for the winter; the corresponding difference in critical frequency may amount to 20%–25% for the period just after sunrise. Comparison of calculated and observed values of f_0F_1 suggests that a representative model of an F region can be based on the assumption that the temperature varies linearly with height up to the F_1/F_2 interface and then remains constant. The parabolic law of variation of electron density is acceptable only for heights corresponding to reflection frequencies not less than 0·7–0·8 times the critical frequency. A general expression is derived relating temperature, electron density, density of matter, recombination coefficient and absorption coefficient.

551.510.535 **3728**

Resonance Scattering by Atmospheric Sodium: Part I—Theory of the Intensity Plateau in the Twilight Airglow.—J. W. Chamberlain. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 73–89.) Numerical results based on theory of radiative transfer are compared with observations by various workers, for a layer scattering solar D-line radiation, observed in the zenith or at zenith distance 75°. Winter observations indicate an absolute brightness slightly greater than given by the theory. Abundance of Na appears to vary between 10^9 (summer) and 10^{10} (winter) atoms/cm^2 (column).

551.510.535 **3729**

The Effect of Ambipolar Diffusion in the Night-Time F Layer.—J. W. Dungey. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 90–102.) The effect is examined in the light of recent low estimates of the density of neutral particles in the F layer [e.g. *Rocket Exploration of the Upper Atmosphere*, 1954, p. 347 (Bates)] and assuming that the rate of loss of electrons is proportional to the electron density, N. With certain other simplifying assumptions, N may be expressed as a sum of functions which decay exponentially with time; an approximately parabolic (Chapman) model based on the most slowly decaying of these is discussed. Correlation is found between both f_0F_1 and the magnetic C figure and the sunspot-cycle variation of the F-region temperature.

551.510.535 **3730**

Observation at Akita of Ionospheric Drift.—Y. Ogata. (*J. Radio Res. Labs, Japan*, April 1956, Vol. 3, No. 12, pp. 135–140.) Simultaneous observations of the variations with time of the virtual heights of the E, E_s and F layers were made at three observatories in Japan, during the period July–August 1955, mainly at night. Drift velocities of the layers are deduced; the results are presented in the form of histograms.

551.510.535 : [523.3 + 523.7 **3731**

Lunar Variations of the F_2 Layer at Ibadan.—R. A. Brown. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 144–154.) Analysis of h_m, y_m, f_0 and h' determinations for the F_2 layer, made at Ibadan from December 1951 to April 1954, shows semidiurnal lunar variations of considerable amplitude; these variations in turn exhibit marked variations of amplitude and phase with season and with time of solar day. Values of the recombination coefficient in the layer, deduced from the luni-solar variations, decrease exponentially with increasing height.

551.510.535 : 523.78 **3732**

Behaviour of the Ionosphere at Rome during the Partial Solar Eclipse of 30th June 1954.—P. Dominici. (*Ann. Geofis.*, Jan. 1956, Vol. 9, No. 1, pp. 107–131.) Observed eclipse effects are compared with effects calculated on the assumption that the electrons are produced by photo-ionization and removed by ionic recombination or attachment to neutral atoms and molecules, and that the ionizing radiation is distributed uniformly over the visible disk of the sun. It is deduced that the electron loss rate is consistent with an ionic recombination process in the E and F_1 layers and with an attachment process in the F_2 layer. The attachment and recombination coefficients decrease with increasing height; their variations during the eclipse are related to the vertical movements of the ionosphere. Seasonal variations between effects observed in a number of eclipses are explained in terms of different degrees of superposition of the F_1 and F_2 layers. The existence of secondary minima of electron density is interpreted as indicating that a distinction must be drawn between the 'ionizing' sun and the visible sun. Eclipse effects in the E_s layer are also discussed. 62 references.

551.510.535 : 523.78 **3733**

Recombination and Attachment in the F_1 and F_2 Layers during the Solar Eclipse of 25 December 1954.—M. E. Szendrei & M. W. McElhinny. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 118–130.) Examination of the variations of electron density at Grahamstown in relation to actual, rather than virtual, heights in the F region during the annular eclipse of 25th December 1954 suggests that there combination process is predominant in the F_1 region; in the F_2 region, recombination and attachment coefficients decrease regularly with height. Possible explanations of the separation of the F_1 and F_2 layers are advanced.

551.510.535 : 537.533.1 : 621.396.11 **3734**

Theory of Nonlinear Effects in the Ionosphere.—Zhevakin & Fain. (See 3856.)

551.510.535 : 621.3.087.4 **3735**

Ionospheric Sounding Equipment.—J. O. Cardus. (*Rev. Geofis., Madrid*, Oct./Dec. 1955, Vol. 14, No. 56, pp. 285–312.) The characteristics of the ionosphere are briefly reviewed and some soundings obtained at the Tortosa station, inaugurated in 1955, are reproduced. The sounding equipment installed is identical with that used by the Bureau Ionosphérique Français.

551.510.535 : 621.396.11 **3736**

Ionospheric Prediction Methods and the Probable Sources of Error.—Baral. (See 3854.)

551.510.535 : 621.396.11 **3737**

Equatorial Ionospheric Absorption.—Skinner & Wright. (See 3855.)

551.510.535 : 621.396.812.3 **3738**

Study of the Selective Fading appearing on the *fct*-Traces.—Uyeda & Nakata. (See 3863.)

551.594.5 **3739**

Height Distribution of Auroral Emissions.—L. Harang. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 157–159.)

551.594.5 : 551.508 : 621.397.424 **3740**

Measurement of Auroral Radiation 3 200 Å with a Photon Counter (Geiger Tube).—E. V. Ashburn. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 156–157.) A copper-cathode G-M counter is satisfactory for measuring this radiation.

551.594.6 : 621.396.821 **3741**

The Level of Interference due to Atmospherics in the Very-Long-Wave Range, and its Diurnal and Seasonal Variations.—Lauter. (See 3868.)

LOCATION AND AIDS TO NAVIGATION

621.396.96 **3742**

Radar Echoes from Birds and Insects.—L. L. Bonham & L. V. Blake. (*Sci. Mon.*, April 1956, Vol. 82, No. 4, pp. 204–209.) General discussion and report of observations confirming Crawford's view (2300 of 1949) that certain otherwise unexplained echoes are in fact due to birds and insects. The quantitative aspects of the phenomena are briefly touched on.

621.396.96 : 621.396.62 : 621.396.822 **3743**

Technical Possibilities for Noise Reduction in the Reception of Weak Radar Signals.—H. Borg. (*Ann. Télécommun.*, May 1956, Vol. 11, No. 5, pp. 90–110.) Known systems for detecting a weak signal in the presence of noise are critically reviewed. The optimum-filter method is most generally useful. Correlation methods are not directly applicable to the detection of moving targets, but are best for detecting very weak periodic signals. 40 references.

621.396.96 : 621.397.2 **3744**

The Transmission of Radar Displays with Compressed Bandwidth.—H. Meinke & H. Groll. (*Nachrichtentech. Z.*, May 1956, Vol. 9, No. 5, pp. 214–221.) Methods using c.r. tubes with line-storage techniques are discussed; the bandwidth can be reduced to 12 kc/s. The requirements in respect of scanning precision are stringent, but much less so than with area storage. Special pulses are used for distortion testing. Photographs show original and transmitted displays obtained at Munich using Decca radar equipment on a tower. The possibility of storing the display on magnetic tape is also discussed.

621.396.96.001.362 **3745**

A Synthetic Radar Trainer.—F. W. Cook. (*A.T.E J.*, April 1956, Vol. 12, No. 2, pp. 89–100.)

621.396.962.2 : 621.376.3 **3746**

A Precise New System of F.M. Radar.—M. A. W. Ismail. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1140–1145.) A system for measurement of both range and speed of the target uses a sinusoidal rather than a symmetrical triangular frequency-modulating waveform. Relatively small frequency deviations are required, and there is no fixed error, hence short ranges can be measured accurately. Brief details are given of an altimeter based on the principles discussed.

621.396.962.3 **3747**

Maximum Angular Accuracy of a Pulsed Search Radar.—P. Swerling. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1146–1155.) "Using a result in the theory of statistical estimation, a lower bound is derived for the standard deviation of regular unbiased estimates of target angular position, for a large class of methods of angular position determination; the lower bound depends on scan rate, pulse repetition rate, beamwidth, beam shape, and signal-to-noise ratio. A similar analysis is made of the limits on angular accuracy imposed by a combination of receiver noise and one particular type of target cross section fluctuation. . . The relation between the estimation of angular position and the problem of target detection is discussed. A graphical presentation of the main results is given."

MATERIALS AND SUBSIDIARY TECHNIQUES

533.5 **3748**

Ionic Pump with Cold Electrodes, and its Characteristics.—E. M. Reikhrudel', G. V. Smirnitskaya & A. I. Borisenko. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 253–259.) The characteristics of an ionic pump using both an electric and a magnetic field were investigated. Pressures down to 5×10^{-8} mm Hg have been obtained in particular cases, the normal working range being 10^{-2}–10^{-7} mm Hg with air, Ne and He.

535.215 : 537.311.33 **3749**

Optical and Electrical Measurements on Caesium-Antimony Layers of Different Composition.—G. Wallis. (*Ann. Phys., Lpz.*, 30th April 1956, Vol. 17, Nos. 6–8, pp. 401–416.) Measurements are reported of the optical absorption and temperature dependence of conductivity for Cs-Sb layers produced by a method giving rise to a stratified structure. The absorption measurements were extended beyond the region of photosensitivity into the infrared. Values are derived and discussed for the activation energy. The nature of the particular compound formed and the influence of the crystal structure on the results are considered. The absorption of films of pure Sb and Cs at wavelengths of 400–1 800 $m\mu$ was also measured.

535.215 + 535.37] : 546.482.21 **3750**

Photoconductivity and Luminescence of Polycrystalline CdS(Cu).—N. A. Tolstoi, B. T. Kolomiets, O. I. Golikova & M. Ya. Tsenter. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 575–576.) Brief report on results of measurements on nine CdS specimens containing up to 10^{-3} g/g Cu and one specimen containing 10^{-3} g/g Cu and 10^{-5} g/g Fe. The results are discussed in relation to the degenerate bimolecular recombination mechanism and the two-step excitation mechanism.

535.215 : 546.817.221 : 539.234 **3751**

Photosensitization of PbS Films.—R. H. Harada & H. T. Minden. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1258–1262.) Experiments are reported in which evaporated PbS films were treated with O_2 and the resulting changes in the photoconductive response were observed. The variations of conductance in the absence and in the presence of illumination are found to be correlated. The photoconduction response time increases monotonically as the film changes from *n* to *p* type. The results are interpreted in terms of two oxygen surface states.

535.37 **3752**

Excitation and Destruction of Phosphors by H^+ Ions.—H. P. Gilfrich. (*Z. Phys.*, 17th April 1956, Vol. 145, No. 2, pp. 241–248.) Measurements have been made of the reduction of luminescence intensity in various inorganic and organic phosphors bombarded by 10-kV H^+ ions. The reduction can be expressed by the formula $I/I_0 = 1/(1 + CN)$, where N is the number of ions and C is the 'destruction constant'. The value of C drops to about a tenth for each step of the series constituted by organic phosphors, sulphides, oxides and alkali halides; the nature of the activator is significant, but the activator concentration is not.

535.37 **3753**

Infrared Luminescence of Zinc and Cadmium Sulphide Phosphors.—P. F. Browne. (*J. Electronics*, July 1956, Vol. 2, No. 1, pp. 1–16.) Garlick & Dumbleton (3234 of 1954) have observed ZnS luminescence at wavelengths near 1·6 μ; the present author has observed corresponding bands for CdS near 1·8 μ. A detailed investigation is reported of the origin of these infrared bands and of their kinetic relations with the emission bands at shorter wavelengths and with other phenomena such as luminescence quenching and photoconductivity. A new infrared stimulation band of the visible luminescence of ZnS has been found at about 2·55 μ; this may correspond to the single thermal glow peak of these phosphors.

535.376 : 546.472.21 **3754**

On the Electroluminescence in ZnS Phosphor.—M. Kimata & T. Nomura. (*J. phys. Soc. Japan*, April 1956, Vol. 11, No. 4, pp. 466–467.) The interpretation of the light output characteristic for applied a.c. fields of 1 800 V/mm is discussed; the effect of d.c. bias is considered.

535.376 : 546.472.21 **3755**

The Effect of Electron Traps on Electroluminescence.—P. D. Johnson, W. W. Piper & F. E. Williams. (*J. electrochem. Soc.*, April 1956, Vol. 103, No. 4, pp. 221–224.) Measurements of the temperature dependence of electro- and thermo-luminescence of ZnS phosphors show that at low temperatures traps may, by field ionization, supply electrons in the region of high field strength; at higher temperatures the traps are thermally emptied, enhancing the field in the barrier region.

535.376 : 621.327.43 **3756**

The Voltage Drop through Phosphor Screens and its Bearing on Performance of Cathodoluminescent Lamps.—L. R. Koller. (*J. electrochem. Soc.*, April 1956, Vol. 103, No. 4, pp. 214–218.) By using a high-conductivity phosphor, such as ZnO, the major part of the voltage across a c.r. tube is made available for light excitation, thus making possible the construction of mains-voltage lamps.

537.226/.227 : [546.431.824-31 + 546.42.824-31 **3757**

The Production and the Dielectric and Optical Properties of Single Crystals of Solid Solutions of Barium and Strontium Titanates.—A. L. Khodakov, M. L. Sholokhovich, E. G. Fesenko & O. P. Kramarov. (*C. R. Acad. Sci. U.R.S.S.*, 11th June 1956, Vol. 108, No. 5, pp. 825–828. In Russian.) Single crystals were prepared from solutions of K_2F_2 of mixtures of Ba and Sr titanates by evaporation of the K_2F_2 at the temperature of crystallization of the solid solutions and subsequent cooling. The temperature characteristics of ϵ are shown graphically for crystals containing 10% and 50% $SrTiO_3$, respectively, before and after thermal treatment; the latter curves show maxima near the temperatures corresponding to the Curie points of polycrystalline specimens. The tan δ/temperature curve for the crystal containing 10% $SrTiO_3$, after thermal treatment, is also shown. The magnitude of tan δ determined at room temperature at a frequency of 10^6 c/s depends on the composition of the crystal and lies between 50×10^{-4} and 500×10^{-4}. Other results are tabulated and oscillograms of the polarization hysteresis effect at temperatures between 27° and 139°C in a specimen containing 5% $SrTiO_3$ are shown.

537.226/.227 : 546.431.824-31 **3758**

Influence of Structure on Hysteresis Effects in $BaTiO_3$ Ceramics.—W. Heywang & R. Schöfer. (*Z. angew. Phys.*, May 1956, Vol. 8, No. 5, pp. 209–213.) Difference between the hysteresis loops for coarse-grained and fine-grained material are discussed. Loop constrictions observed with coarse-grained material disappear on prolonged subjection to an alternating field. The relaxation time associated with this effect decreases as the applied alternating field increases and as the grain size increases, and also as the ferroelectric Curie point is approached.

537.226/.227 : 546.431.824-31 **3759**

Polarization Reversal in the Barium Titanate Hysteresis Loop.—R. Landauer, D. R. Young & M. E. Drougard. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 752–758.) The a.f. hysteresis loop of tetragonal $BaTiO_3$ is examined in relation to Merz's finding (445 of 1955) that the rate at which the polarization reverses in an applied field of intensity E is proportional to $e^{-\alpha/E}$, where α depends on temperature. The switching rate adjusts to variations in the applied field with a time lag whose order of magnitude does not exceed 10^{-8} sec. The results imply that domains cross the crystal with a speed of the order of that of sound. Increases in dielectric constant measured during switching remain unexplained.

537.226 : 539.215 **3760**

Effective Dielectric Constant of Heterogeneous Media.—R. S. Smith. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 824–831.) A formula is derived for calculating the effective dielectric constant of powders as a function of particle shape, intrinsic dielectric constant, density of the powder, and the packing properties of elliptical particles. On inserting experimentally obtained values for various materials, including silica and polystyrene, results are obtained in agreement with those of other workers for the dielectric constants of the bulk material.

537.311.3 : 538.632 : 539.217 **3761**

Hall Effect and Conductivity in Porous Media.—H. J. Juretschke, R. Landauer & J. A. Swanson. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 838–839.) Formulae are derived based on the assumption that all the pores are completely surrounded by the conducting material but none of the conducting material is completely surrounded by space.

537.311.31 : 539.23 **3762**

The Resistivity of Very Thin Metal Films.—G. Darmois. (*C. R. Acad. Sci., Paris*, 16th July 1956, Vol. 243, No. 3, pp. 241–243.) Theory accounting for observed variations of resistivity with thickness and temperature is outlined; as the thickness is increased the conduction changes from a two-dimensional to a three-dimensional process.

537.311.31 : 546.57 : 539.234 **3763**

Variation of Conductivity of Thin Evaporated Films of Silver with Electrostatic Charging.—A. Deubner & K. Rambke. (*Ann. Phys., Lpz.*, 30th April

1956, Vol. 17, Nos. 6–8, pp. 317–328.) Experiments were made with the object of explaining discrepancies between observations reported previously by various workers. The results indicate that the discrepancies are probably due to the magnitude of the effect decreasing as the films age. Some related effects associated with prolonged passage of current are also discussed.

537.311.33 **3764**

The Electrical Behaviour of Bicrystal Interface Layers.—H. F. Matare. (*Z. Phys.*, 17th April 1956, Vol. 145, No. 2, pp. 206–234.) Extension of previous investigations (e.g. 3086 of October). Methods are discussed for preparing bicrystals with desired orientation. A bicrystal with appropriately polarized interface layer exhibits transistor properties similar to those of the *n-p-n* impurity-containing transistor, with the possibility of improved h.f. performance.

537.311.33 **3765**

Formation of *p-n* Junctions in Semiconductors by the Variation of Crystal Growth Parameters.—H. E. Bridgers. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 746–751.) The dependence of the distribution of impurities between liquid and solid phases on the growth rate of crystals grown from a melt and on the amount of stirring is discussed.

537.311.33 **3766**

Theory of Transport Effects in Semiconductors: the Nernst Coefficient, and its Relation to Thermo-electric Power.—P. J. Price. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1245–1251.) Theory presented previously (1079 of April) is extended to give an expression consistent with that derived by Putley (2028 of 1955) for the complete Nernst coefficient. The information obtainable from experimental values of this coefficient and of the thermoelectric power is discussed in the light of the theory. An estimate is made of the anomaly in the Nernst coefficient due to the phonon drag effect.

537.311.33 : 061.3 **3767**

Conference on the Theory of Semiconductors.—G. E. Pikus & Yu. A. Firsov. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2381–2394.) Report of a conference held by the U.S.S.R. Academy of Sciences in Leningrad in February 1955. Extensive summaries of the papers read and the discussions are given. The papers are grouped under the following headings: theory of polarons; multi-electron theory of semiconductors; magnetic properties of semiconductors; theory of excitons; theory of mobility and of thermo- and galvano-magnetic effects; theory of liquid and amorphous semiconductors; theory of non-radiative transitions; theory of rectification; catalytic action of semiconductors. The research program decided upon by the conference is given in full.

537.311.33 : 061.3 **3768**

The Physics of Semiconductor Surfaces.—C. G. B. Garrett. (*Nature, Lond.*, 25th Aug. 1956, Vol. 178, No. 4530, p. 396.) Brief account of a conference held in Philadelphia in June 1956. The papers are to be published in book form by the University of Pennsylvania Press.

537.311.33 : 535.215 : 621.311.6 **3769**

Theoretical Considerations governing the Choice of the Optimum Semiconductor for Photovoltaic Solar-Energy Conversion.—J. J. Loferski. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 777–784.) In consequence of the modification of the spectral distribution of solar energy due to atmospheric absorption, the optimum value of the semiconductor energy gap for conversion of solar energy ranges between 1·2 and 1·6 eV for different times and locations. Possible departures of the *p-n*-junction rectifier characteristic from that indicated by simple theory may reduce the advantages of these energy-gap values over others in the range 1·1 – 2·0 eV. Calculations yield efficiency values for InP, GaAs and CdTe greater than the values predicted for Si, CdS, Se and AlSb.

537.311.33 : 535.37 **3770**

Theory of Impurity-Centre Electrons: Part 1—Optical Transitions.—G. Helmis. (*Ann. Phys., Lpz.*, 30th April 1956, Vol. 17, Nos. 6–8, pp. 356–370.) A method of calculating the probability of optical transitions at impurity centres is presented.

537.311.33 : [537.32 + 536.21 **3771**

On the Thermal Conductivity and Thermoelectric Power of Semiconductors.—D. ter Haar & A. Neaves. (*Advances Phys.*, April 1956, Vol. 5, No. 18, pp. 241–269). A comprehensive discussion of scattering mechanisms in semiconductors, neglecting the influence of deviations from spherical energy surfaces and of many-electron phenomena, and assuming only one type of carrier to be present. Six temperature ranges are hence distinguished; expressions are derived for the thermal conductivity and thermoelectric power in each range. The theoretical results are in qualitative agreement with such experimental results as are available.

537.311.33 : 537.32 **3772**

Theory of the Transverse Magneto-thermo-electric Effect in Semiconductors.—M. Rodot. (*C. R. Acad. Sci., Paris*, 9th July 1956, Vol. 243, No. 2, pp. 129–132.) The laws governing the variation of the Seeback effect in the presence of a transverse magnetic field are established, starting from Boltzmann's transport equation and assuming dispersion of charge carriers by ionization impurities.

537.311.33 : 537.32 **3773**

Thermoelectric Properties of the Compound $CrSb_2$.—N. Kh. Abrikosov & V. F. Bankina. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1956, Vol. 108, No. 4, pp. 627–628. In Russian.) The temperature coefficient of thermo-electric force of this semiconducting compound varies between $-81\,\mu V/°C$ at 18°C and $-22\,\mu V/°C$ at 437°C, the conductivity at these temperatures being $6{\cdot}4\,\Omega^{-1}.cm^{-1}$ and $43{\cdot}6\,\Omega^{-1}.cm^{-1}$, respectively. Results of measurements between these temperatures are tabulated and the effect of a small variation of the composition of the compound on the conductivity and thermoelectric force at 550°C is shown graphically.

537.311.33 : 546.26-1 **3774**

Electronic Band Structure of Diamonds.—J. J. Brophy. (*Physica*, March 1956, Vol. 22, No. 3, pp. 156–158.) A band structure similar to that found in other group-IV elements is proposed; the differences between the various types of diamond are explained as effects of impurities.

537.311.33 : [546.28 + 546.289 **3775**

Some Defects in Crystals grown from the Melt: Part 1—Defects caused by Thermal Stresses.—E. Billig. (*Proc. roy. Soc. A.*, 10th April 1956, Vol. 235, No. 1200, pp. 37–55.) A study of monocrystals of Ge and Si pulled from the melt under extreme conditions of temperature gradient and thermal stress is reported. Reasonable correlation has been obtained between the density of the etch-pits marking the dislocations and characteristics of the ingot such as lifetime of minority carriers, transistor action and the highest inverse voltage that can be sustained at the rectifying point contact. For solid-state devices requiring material of highest

perfection, the portion near the centre of the ingot is probably most suited. Eight plates showing crystal defects are included.

537.311.33 : [546.28 + 546.289 **3776**

Note on Hydrogen in Germanium and Silicon.—J. H. Crawford, Jr, H. C. Schweinler & D. K. Stevens. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 839–840.) Crystal-growing techniques for Ge and Si normally involve use of a hydrogen atmosphere; possible mechanisms of dispersal of the excess hydrogen in these materials are discussed.

537.311.33 : 546.289 **3777**

Vapor-Phase Crystal Growth of Germanium from Thermally Decomposed Germane.—M. Davis & R. F. Lever. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 835–836.) Single crystals of Ge heated to within 200°C of their melting point (936°C) have been exposed to controlled low pressures of germane (GeH_4) and the resulting crystal growths studied. Satisfactory conditions were not established for the preparation of *p-n* junctions by co-deposition of donor elements from their hydrides or by evaporation of acceptor elements. Photomicrographs are reproduced of several types of crystal growth observed.

537.311.33 : 546.289 **3778**

Slow Surface Reaction on Germanium.—S. R. Morrison. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1297–1301.) "An experimental study of the long decay time levels has shown that the reaction between the levels and the bulk germanium depends on the number of carriers in the germanium, on the oxygen pressure, and exponentially on the temperature. It is therefore suggested that the rate-limiting process is electron transfer over a surface barrier. A simplified model, based on this mechanism, yields adequate agreement with the present results and also with those obtained by Kingston."

537.311.33 : 546.289 **3779**

Annealing of Germanium supersaturated with Nickel.—P. Penning. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1414–1415.) The work of van der Maesen & Brenkman (3589 of 1954) is discussed and a brief report is given of experiments made to determine how the density of Ni acceptor levels changes during the annealing of a supersaturated Ge sample.

537.311.33 : 546.289 **3780**

Hole Trapping in Germanium bombarded by High-Energy Electrons.—R. G. Shulman. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1451–1455.) From measurements of the time variation of photoconductivity in *n*-type Ge specimens previously bombarded by 3-MeV electrons, the existence of hole traps at a level 0·28 eV above the valence band was established. Trap densities ranged between 5×10^{12}/cm^3 and 5×10^{14}/cm^3 in the specimens studied.

537.311.33 : 546.289 **3781**

Copper in Germanium: Recombination Center and Trapping Center.—R. G. Shulman & B. J. Wyluda. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1455–1457.) Measurements of the time-variation of photoconductivity of Cu-doped *n*- and *p*-type Ge specimens over the temperature range 130°–293°K indicate the presence at the lower temperatures of hole traps in the *n*-type specimens but not in the *p* type. Trap concentrations agree with the concentrations of Cu atoms to within a factor of 2, and are at least 100 times higher than for undoped crystals. The trapping level is 0·2 eV above the valence band. While the capture cross-section for holes is independent of temperature, the capture cross-section for electrons is temperature-dependent; as a result, the 0·2 eV Cu level changes from a recombination centre at room temperature to a hole trap at lower temperatures.

537.311.33 : 546.289 : 537.29 **3782**

The Field-Dependence of Electron Mobility in Germanium.—J. B. Gunn. (*J. Electronics*, July 1956, Vol. 2, No. 1, pp. 87–94.) Pulse current measurements were made on filaments and rectangular bars of 2-Ω.cm *n*-type Ge with uniform cross-sections of about 0·5 mm^2. Results indicate that the electron drift velocity v becomes constant for values of electric field strength E between $4{\cdot}5 \times 10^3$ and 9×10^3 V/cm. At higher values of E, v increases approximately as $E^{0{\cdot}134}$, avalanche multiplication apparently setting in at $E = 6{\cdot}3 \times 10^4$ V/cm.

537.311.33 : 546.289 : 537.312.8 **3783**

Weak-Field Magnetoresistance of *n*-Type Germanium.—C. Goldberg & R. E. Davis. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1254–1257.) Results of measurements over the temperature range 77°–320°K support the validity of the model which assumes that the energy surfaces are (111) ellipsoids. The most consistent analysis indicates that the mass ratio is nearly constant at about 11·9 in this temperature range but the scattering mechanism is temperature-dependent.

537.311.33 : 546.289 : 539.163 **3784**

Disintegration of Ge.—B. Crasemann, D. E. Rehfuss & H. T. Easterday. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1344–1346.)

537.311.33 : 546.289 : 541.135 **3785**

The Anode Behavior of Germanium in Aqueous Solutions.—D. R. Turner. (*J. electrochem. Soc.*, April 1956, Vol. 103, No. 4, pp. 252–256.) Results of experiments indicate that a voltage barrier forms with anodes of *n*-type Ge but not with *p*-type. Effects observed during anodic dissolution are consistent with two electrons and two holes being involved for each Ge atom dissolving.

537.311.33 : 546.3-1-28-289 **3786**

Galvanomagnetic Effects in a Semiconductor with Two Sets of Spheroidal Energy Surfaces.—M. Glicksman. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1496–1501.) "The conductivity, Hall coefficient, and low-field magnetoresistance are calculated for a semiconductor with conduction in two sets of spheroids, one set oriented along [100] directions, the other along [111] directions in reciprocal lattice space. These calculations are used in an analysis of experimental data on alloys of twelve to seventeen percent silicon in germanium. A good fit to the data is obtained assuming such a conduction band, with the shape of the [111] spheroids similar to that found in germanium and the shape of the [100] spheroids like those in silicon. Some interband scattering is introduced to give the observed mobility variation with composition. The calculated energy separations of the [111] and the [100] minima depend strongly on the scattering assumed."

537.311.33 : 546.368.63 : 537.533.8 **3787**

Secondary Emission from Antimony-Caesium Cathode at Low Primary-Electron Energies.—E. S. Mashkova. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 260–261.) Brief report of experimental results. The threshold level for the secondary electron emission was found to coincide with the photoelectric work function; this indicates that the secondary electrons originate in the filled zone of Cs_3Sb.

537.311.33 : 546.472.21 **3788**

Adsorption and Surface Potential of Semiconductors: Part 2—Surface Vacancies and its Reaction with Oxygen on ZnS.—A. Kobayashi & S. Kawaji. (*J. phys. Soc. Japan*, April 1956, Vol. 11, No. 4, pp. 369–375.) Part 1: 3299 of 1955.

537.311.33 : 546.48.241.1 **3789**

Electrical Properties of Cadmium Telluride.—B. I. Boltaks, P. P. Konorov & O. A. Matveev. (*Zh. tekh. Fiz.*, Nov. 1955, Vol. 25, No. 13, pp. 2329–2335.) Experiments have shown a large variation in the values of activation energy for different specimens and also, for some specimens, a decrease of this energy at high temperatures. A possible explanation of these phenomena is given.

537.311.33 : 546.48.241.1 **3790**

The Dielectric Constant of CdTe.—D. de Nobel & D. Hofman. (*Physica*, March 1956, Vol. 22, No. 3, p. 252.) Values of ϵ obtained by measurements on p-type crystals with room-temperature resistivity $1{\cdot}5 \times 10^3$ Ω.cm are $10{\cdot}9 \pm 0{\cdot}3$ at 20°K and $11{\cdot}0 \pm 0{\cdot}3$ at 77°K, at frequencies up to 100 kc/s; tan δ is also tabulated.

537.311.33 : 546.482.21 **3791**

Evidence for Hole Mobility in CdS.—G. Diemer & W. Hoogenstraaten. (*Physica*, March 1956, Vol. 22, No. 3, p. 172.)

537.311.33 : 546.482.21 : 621.396.822 **3792**

Electronic Noise in CdS Single Crystals at High Field Strengths.—K. W. Böer, U. Kümmel & G. Molgedey. (*Ann. phys., Lpz.*, 30th April 1956, Vol. 17, Nos. 6–8, pp. 344–355.) Measurements were made of noise at field strengths in the region of breakdown, using a wide-band amplifier; the frequency range covered was 200 c/s–60 kc/s. The results are discussed in relation to Gisolf's theory of the fluctuations of conduction electrons (667 of 1950).

537.311.33 : [546.682.19 + 546.682.86 **3793**

Effective Electron Mass in Indium Arsenide and Indium Antimonide.—R. P. Chasmar & R. Stratton. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1686–1687.) Values derived from measurements of Hall effect and thermoelectric power are discussed briefly.

537.311.33 : 546.682.86 **3794**

Hall Effect and Electrical Resistivity of InSb in Strong Magnetic Fields and at High Pressures.—J. Gielessen & K. H. v. Klitzing. (*Z. Phys.*, 17th April 1956, Vol. 145, No. 2, pp. 151–155.) Measurements supplementary to those of Long (161 of January) and Keyes (162 of January) are reported. The variations of Hall coefficient and resistivity with pressure are similar; it is deduced that the number of charge carriers is strongly dependent on the pressure, while the mobility is only weakly dependent.

537.311.33 : 546.811-17 **3795**

Hall Effect in Gray Tin Filaments.—E. E. Kohnke & A. W. Ewald. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1481–1486.) Continuation of previous experiments [2330 of 1955 (Ewald & Kohnke)] on wires of diameter 0·1 mm. Measurements were made over the temperature range from 70° to 270°K. Expressions are derived for the temperature dependence of the charge-carrier mobilities and the energy gap, and a value is hence deduced for the effective carrier mass. There is no indication of extremely high mobility ratios such as those found in InSb.

537.311.33 : 621.396.822 **3796**

Electronic Noise in Semiconductors.—K. M. van Vliet & J. Blok. (*Physica*, March 1956, Vol. 22, No. 3, pp. 231–242.) The presence of three sources of fluctuations is deduced from the continuity equation for one independent variable; these fluctuations are briefly considered. A matrix equation is derived, from which the variances and covariances of several stochastic variables can be calculated if all generation and recombination probabilities are known.

538.1 : 538.22 **3797**

Theory of Ferro-, Para- and Ferri-magnetism.—N. S. Akulov. (*C. R. Acad. Sci. U.R.S.S.*, 1st June 1956, Vol. 108, No. 4, pp. 603–606. In Russian.)

538.22 **3798**

Magnetic Properties of Colloidal Nickelous Oxide.—J. T. Richardson & W. O. Milligan. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1289–1294.) Measurements of the magnetic susceptibility over the temperature range 4°–550°K are reported. The results indicate that this material may have ferromagnetic properties.

538.22 **3799**

Ferrimagnetism of Mn_4N.—R. Juza & H. Puff. (*Naturwissenschaften*, May 1956, Vol. 43, No. 10, p. 225.) A brief note on the structure and magnetic properties of the material; the effects of substituting C for the N and Cu for the Mn are discussed.

538.22 : 621.318.134 **3800**

An Antiferromagnetic Transition in Zinc Ferrite.—J. M. Hastings & L. M. Corliss. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1460–1463.) From neutron diffraction measurements over the temperature range 2·7°–300°K it is inferred that Zn ferrite undergoes a transition from a paramagnetic to an antiferromagnetic state at around 9°K. A model consisting of an antiferromagnetic alternation of ferromagnetic 'bands' is discussed in relation to the observed line intensities.

538.221 **3801**

Temperature Dependence of the Hall Coefficients in some Copper Nickel Alloys.—F. E. Allison & E. M. Pugh. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1281–1287.)

538.221 **3802**

Domain Structure as affected by the Uniaxial Ferromagnetic Anisotropy induced in Cubic Solid Solutions.—M. Yamamoto, S. Taniguchi & K. Aoyagi. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1295–1297.) Experimental evidence indicates that the perminvar-type properties of Co-Ni alloys are due to stabilization of the domain walls by uniaxial anisotropy induced when the material is cooled slowly from above its Curie temperature in the absence of an external magnetic field.

538.221 **3803**

New Magnetic Anisotropy.—W. H. Meiklejohn & C. P. Bean. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1413–1414.) Exchange anisotropy resulting from an interaction between ferromagnetic cobalt particles and a coating of antiferromagnetic cobaltous oxide has been observed.

538.221 **3804**

New Low-Temperature Ferromagnets.—A. N. Holden, B. T. Matthias, P. W. Anderson & H. W. Lewis. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, p. 1463.)

Large positive susceptibilities and ferromagnetic remanence have been observed in complex cyanides of elements of the 3*d* transition group at very low temperatures.

538.221 **3805**

Powder Patterns and Magnetization Processes in High-Coercivity Alnico Magnets.—A. Kussmann & J. H. Wollenberger. (*Z. angew. Phys.*, May 1956, Vol. 8, No. 5, pp. 213–216.) The existence of domain structure has been demonstrated by means of the Bitter technique in oriented alnico specimens with a coercive force of 670 oersted. The patterns form stripes roughly in the direction of the magnetic field applied during the cooling process.

538.221 : 536.631 **3806**

Specific Heat of a Magnetite Crystal at Liquid Helium Temperatures.—J. S. Kouvel. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1489–1490.)

538.221 : 536.7 **3807**

Components of the Thermodynamic Functions of Iron.—R. J. Weiss & K. J. Tauer. (*Phys. Rev.*, 15th June 1956, Vol. 102, No. 6, pp. 1490–1495.)

538.221 : 546.73.241 **3808**

Note on the Ferromagnetism of CoTe.—E. Uchida. (*J. phys. Soc. Japan*, April 1956, Vol. 11, No. 4, pp. 465–466.) The conclusions drawn previously (488 of February) are shown to be unjustified; the magnetic behaviour found is explained on the basis that $CoTe_x$ ($1{\cdot}00 < x < 1{\cdot}20$) is a eutectic mixture of metallic Co and a nonmagnetic compound $CoTe_{1{\cdot}29}$.

538.221 : 621.318.134 **3809**

Nickel Copper Ferrites for Microwave Applications.—L. G. Van Uitert. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 723–727.) Materials with relatively high density and high d.c. resistivity ($> 10^9\ \Omega$.cm) can be prepared by sintering Ni-Cu ferrites having a deficiency of Fe combined with small additions of Mn or Co. Magnetic saturation at room temperature varies linearly with Cu content. An anomalous break in the d.c.-resistivity/composition curve occurs at the point where the Cu/Ni ratio is 1 : 2.

546.82 : 534.86 **3810**

Application of Metal Titanium to the Acoustic Instruments, in Japan.—T. Hayasaka, K. Masuzawa, S. Nagai & M. Suzuki. (*Rep. elect. Commun. Lab., Japan*, April 1956, Vol. 4, No. 4, pp. 39–54.)

549.514.51 : [539.31 + 537.226 **3811**

Anelasticity and Dielectric Loss of Quartz.—R. K. Cook & J. H. Wasilik. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 836–837.) Additional experimental evidence is presented indicating that the effects reported by Cook & Breckenridge (1838 of 1954) and Stuart (1474 of May) are caused by the same physical mechanism.

621.3.035.4 **3812**

The Linearity of Electrolytic Impedances.—G. S. Buchanan & F. Gutmann. (*C. R. Acad. Sci., Paris*, 23rd July 1956, Vol. 243, No. 4, pp. 374–378.) It has been observed that the conductance of an electrolyte measured at a given frequency is totally independent of the presence or absence of a field at a different frequency. This phenomenon is explained as resulting from the presence of a double layer which introduces a capacitance so large that its reactance is negligible in comparison with the series resistance of the solution, even at very low frequencies.

621.3.066.6 **3813**

Electrical Contacts.—J. T. Pender. (*Elect. J.*, 6th April 1956, Vol. 156, No. 4060, pp. 1064–1068.) Aspects of theory, design and choice of materials are discussed. See also *ibid.*, pp. 1069–1071.

621.315.61 : 539.16 **3814**

Impact of High-Energy Radiation on Dielectrics.—A. E. Javitz. (*Elect. Mfg*, June 1955, Vol. 55, No. 6, pp. 85–104.) A survey of the mechanical and electrical effects of particle irradiation on various dielectric materials, particularly plastics.

621.315.612.4 : 546.431.824-31 **3815**

Antimonates as Additives to Barium Titanate Dielectric Bodies.—W. W. Coffeen. (*J. Amer. ceram. Soc.*, 1st April 1956, Vol. 39, No. 4, pp. 154–158.) Additions of the antimoniates of Na, Li, Ba, Sr and Pb to $BaTiO_3$ caused depression of the Curie peak; dielectric constants of 2 000 or less were observed for these compounds, showing little variation with temperature. Addition of $Mg_2Sb_2O_7$ produced a marked downward shift in the temperature of the Curie peak.

621.315.613.1 **3816**

X-Ray Diffraction Studies of some Mica Species of India.—N. S. Nampoothiry & R. V. G. S. Rao. (*J. Indian Inst. Sci.*, Section A, April 1956, Vol. 38, No. 2, pp. 100–107.)

621.315.616 : 621.396.822 **3817**

Some Recent Studies of Random Noise between Metals and Dielectrics.—S. I. Reynolds. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 728–734.) Experiments supplementary to those described previously [e.g. 3478 of 1952 (Bauss & Boyer)] were made to determine the origins of noise in thin layers of polymeric insulating materials. Application of a direct voltage of 300 V to dry films was sufficient to give rise to a steady noise voltage if the electrodes were not in intimate contact. Noise observed on reversing a voltage up to 1 425 V applied to a two-phase dielectric ceased when the current reached its steady value. The methods described are useful for detecting ionization in very small voids.

621.791.3 : 546.28 **3818**

Five Metal Hydrides as Alloying Agents on Silicon.—M. V. Sullivan & J. H. Eigler. (*J. electrochem. Soc.*, April 1956, Vol. 103, No. 4, pp. 218–220.) The hydrides of Ti, V, Zr, Nb and Ta are found to be effective as fluxes in soldering contacts to both *n*- and *p*-type Si.

MATHEMATICS

517.632 **3819**

Inverse Laplace Transforms expressed as Neumann Series.—E. Cambi. (*J. Math. Phys.*, April 1956, Vol. 35, No. 1, pp. 114–122.)

517.9 **3820**

On the Classification of the Ordinary Differential Equations of Field Theory.—P. Moon & D. E. Spencer. (*Quart. appl. Math.*, April 1956, Vol. 14, No. 1, pp. 1–10.)

517.9 : 681.142 **3821**

Extension of Field of Application of Relaxation Methods of Computation.—B. E. Knight: D. N. de G. Allen. (*Nature, Lond.*, 25th Aug. 1956, Vol. 178, No. 4530, pp. 433–434.) The possibilities of solving linear and nonlinear partial differential equations by relaxation methods, using computers, are discussed.

MEASUREMENTS AND TEST GEAR

53.087.9 **3822**

A Semi-automatic Pen-Recorder Chart Analyser.—C. W. Spencer & G. H. Bazzard. (*J. sci. Instrum.*, June 1956, Vol. 33, No. 6, pp. 228–229.) The contact arm of a multi-contact switch connected to a pulse generator is made to follow the chart trace. Counters brought into circuit by the moving switch arm record pulse counts proportional to the time the trace is between pre-selected levels.

531.761 + 529.7 + 621.3.018.41(083.74) **3823**

Standards of Time and Frequency.—G. M. Clemence. (*Science*, 6th April 1956, Vol. 123, No. 3197, pp. 567–573.) Basic concepts are reviewed. Problems involved in the concurrent use of an atomic and an astronomical standard are discussed. See also 1153 of April.

621.317.3 : 537.311.33 **3824**

Contactless Method for the Estimation of Resistivity and Lifetime of Semiconductors.—H. K. Henisch & J. Zucker. (*Rev. sci. Instrum.*, June 1956, Vol. 27, No. 6, pp. 409–410.)

621.317.3.029.63 : 621.396.822 **3825**

Noise Measurements in the 3-cm Waveband using a Hot Source.—H. Sutcliffe. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 673–677.) "The method discussed uses the noise power produced in a waveguide termination at temperatures up to 600°C as a standard source of low-level power. A suitable type of hot source and associated waveguide and detecting circuits are described. Some experimental results are given of measurements on the effective temperature of a gas-discharge tube used as a secondary standard source."

621.317.32 : 621.396.621 : 621.376.3 **3826**

Measurements of Interference Radiation from F.M. Receivers, carried out in Switzerland by a Group of Experts of the International Electrotechnical Commission Subcommittee 12-1 (Radio Communications—S.C. Measurements).—J. Meyer de Stadelhofen. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st April 1956, Vol. 34, No. 4, pp. 158–166. In French.) Measurements were made on 14 f.m. receivers from six different countries, using various methods, the main features of which are tabulated. Measurements at distances of 30, 10 and 3 m give practically equivalent results. The Seright-Anderson method, in which the measurements are made at a distance of 3 m, is probably most suitable for standardization.

621.317.6 : 519.272.1 **3827**

Technique for Approximate Measurement of Correlation Coefficients.—T. P. Goodman. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 773–775.) "This method makes use of simple analog-computing elements to obtain the coefficient of linear regression of one variable on the other. Its use in connection with an oscilloscope display of the two variables is described, and the relation between these displays and the Lissajous figure formed by two sinusoids is discussed. A possible design for a direct-reading correlation meter is suggested."

621.317.6 : 621.396.822 **3828**

Calculating Noise Level in Radar Receivers.—D. W. Haney. (*Tele-Tech & Electronic Ind.*, May 1956, Vol. 15, No. 5, pp. 74–75 . . 123.) For a receiver in which the second detector is a valve diode, the r.m.s. noise level is derived simply in terms of equivalent input voltage from the r.f.-input/second-detector-output characteristic. The method is based on the theory of Rice for nonlinear detectors (2168 and 2169 of 1945); its application to the present case is justified theoretically and an experimental verification is described.

621.317.7.029.63 : 537.54 : 621.396.822 **3829**

Absolute Calibration of a Standard-Temperature Noise Source for Use with S-Band Radiometers.—V. A. Hughes. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 669–672.) "To provide a standard-temperature noise source for use with S-band radiometers, the noise power from the argon discharge tube CV1881 has been calibrated at 2 860 Mc/s using radiometer techniques. The absolute value of the effective temperature of the tube with a discharge current of 180 mA, when mounted across a waveguide parallel to the E-plane and properly matched, is 11 140°K (15·73 dB) with a maximum error of 260°K (0·10 dB), and represents a considerable improvement in accuracy over previous measurements. Since this tube shows a high degree of stability and consistency it is suggested that it could be used as an absolute standard of noise source for the measurement of the noise factor of receivers."

621.317.7.087.6 **3830**

Servo-Operated Recording Instruments.—A. J. Maddock. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 617–632.) A historical review of these instruments is presented, followed by a detailed discussion of the principal modern types, classified according to the circuit component which is varied to produce balance; this may be a resistor, a capacitor, or an electromagnetic device. Function plotters, scanning recorders and other special types are included.

621.317.715.087 **3831**

Wide-Amplitude String Galvanometer for Direct Recording.—L. B. Browder. (*Rev. sci. Instrum.*, June 1956, Vol. 27, No. 6, pp. 363–368.) The use of compliant end supports for the string makes possible an extended frequency range; a string 10 cm long, having a resonant frequency of 230 c/s, can be made to vibrate with an amplitude of 2·5 cm.

621.317.725/.726 **3832**

The Modern Valve Voltmeter and its Uses.—G. Hitchcox. (*Brit. Commun. Electronics*, May 1956, Vol. 3, No. 5, pp. 238–242.) The short survey presented includes descriptions of seven modern types of instrument and a guide to the selection of instruments for various applications. The characteristics of 27 instruments, mainly of British manufacture, are tabulated.

621.317.729.1 : 681.142 **3833**

An Automatic Electron-Trajectory Tracer.—H. I. Pizer, J. G. Yates & K. F. Sander. (*J. Electronics*, July 1956, Vol. 2, No. 1, pp. 65–86.) Field measurements are made using an electrolytic tank, and the equations of electron motion are hence derived using a specially designed digital computer. The results of the computation are fed back to the tank so that the measuring probes automatically trace the required trajectory.

621.317.74 : 621.397.6.001.4 **3834**

Portable Color-Signal Generator.—J. R. Popkin-Clurman. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 170–172.) The circuit described provides a signal including a horizontal synchronizing pulse, a 3·58-Mc/s reference burst and black, colour and white bars.

621.317.77 **3835**

A Fast-Acting Phase-Conscious Indicator.—D. L. Davies. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 385–387.) A phase-sensitive rectifier circuit consists of two similar cathode followers connected in parallel and gated by applying to the grids rectangular-waveform voltages of signal frequency, 180° out of phase. In an instrument designed to operate over the frequency range 60 c/s–24 kc/s, second- and third-harmonic rejection and quadrature-signal rejection were all > 100/1.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

531.768 : 551.51 **3836**

Transit-Time Accelerometer.—L. M. Jones. (*Rev. sci. Instrum.*, June 1956, Vol. 27, No. 6, pp. 374–377.) A device is described for measuring the drag acceleration of spheres dropped from rockets, thus permitting the density and temperature of the upper atmosphere to be determined. A bobbin is periodically held and released within a cavity contained in the falling sphere; the time taken for the released bobbin to reach the cavity wall is measured. A range from 5×10^{-3} *g* to 5 *g* is covered.

535.82 : 621.397.6 **3837**

Television Microscopy.—W. Köhler. (*Optik, Stuttgart*, 1956, Vol. 13, No. 4, pp. 186–191.) Apparatus combining an ordinary microscope with electronic pickup and reproduction of the image is discussed. Both photoemissive and photoconductive pickup tubes have been used. One of the advantages of the system over the usual optical projection system is that contrast can be controlled to some extent, leading to improved resolution in some cases.

539.172.4 : 621.317.7 : 621-52 **3838**

Control of Nuclear Reactors.—(*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 564–616.) Four papers and discussion dealing with experimental reactors are presented:—

The Control and Instrumentation of a Nuclear Reactor.—A. B. Gillespie (pp. 564–576).

The Control of Nuclear Reactors.—R. J. Cox & J. Walker (pp. 577–589).

Nuclear-Reactor-Control Ionization Chambers.—W. Abson & F. Wade (pp. 590–596).

Some Design Aspects of Nuclear-Reactor Control Mechanisms.—G. E. Lockett (pp. 597–607).

Discussion (pp. 607–616).

550.837 : 538.556.2.029.42 **3839**

Possibility of using the Intrinsic Electromagnetic Field Impedance of the Earth for investigating its Upper Layers.—A. N. Tikhonov & D. N. Shakhsuvarov. (*Bull. Acad. Sci. U.R.S.S., sér. géophys.*, April 1956, No. 4, pp. 410–418. In Russian.) The use of v.l.f. e.m. waves for investigating stratified conducting media is considered theoretically and some quantitative calculated results are given.

621.316.825 : 616-7 **3840**

Thermistor Hypodermic Needle for Subcutaneous Temperature Measurement.—J. Krog. (*Rev. sci. Instrum.*, June 1956, Vol. 27, No. 6, pp. 408–409.)

621.317.39 : 531.77 **3841**

Potentiometer Tachometer has High Sensitivity.—G. M. Davidson & M. Pavalow. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 158–161.) By using a linear potentiometer transducer to feed a differentiating operational amplifier a direct output voltage proportional to the input rate is obtained. Rotation in either direction may be measured by using duplicate channels suitably switched. An accuracy within about 0·5% is obtained without special temperature compensation; the minimum speed measurable is 1/200 rev/min, with a range of 16 000 : 1.

621.387.43 : 535.376 **3842**

The Voltage Drop through Phosphor Screens and its Bearing on Performance of Cathodoluminescent Lamps.—Koller. (See 3756.)

621.365.55 **3843**

The Electric Field of a Dielectric Heating Work Circuit.—N. H. Langton & E. E. Gunn. (*J. Brit. Instn Radio Engrs*, Aug. 1956, Vol. 16, No. 8, pp. 414–424.) A theoretical investigation is made of work circuits in which the lower capacitor plate is larger than the upper; the fringing effect and the relation between specimen and capacitor-plate dimensions are studied. Some experiments on field plotting using an electrolytic analogue are described.

621.383.5 : 531.745 **3844**

Balloon-Borne System for tracking the Sun.—H. D. Edwards, A. Goddard, Jr, M. Juza, T. Maher & F. Speck. (*Rev. sci. Instrum.*, June 1956, Vol. 27, No. 6, pp. 381–385.) Photoelectrically controlled apparatus weighing 125 lb is described, capable of pointing a 20-lb load at a predetermined elevation and azimuth with an accuracy of ± 15′. Results of balloon flights attaining an altitude > 100 000 ft are given.

621.384.6 : 621.319.339 **3845**

Some Problems on the Design and Construction of Nuclear-Physics Particle Accelerators for Particle Energies of a few MeV.—K. Simonyi. (*Nuovo Cim.*, 1956, Vol. 3, Supplement, No. 3, pp. 345–362. In German.) Particles of energies down to 0·03 MeV are useful for research and practical applications. The range of applications corresponding to different ranges of energy values is shown graphically; for energies up to a few MeV, direct accelerators with cascade or Van de Graaff generators are used. A model with a Van de Graaff generator developed at Budapest is described. The same material is presented in two consecutive papers, in German, in *Acta tech. Acad. Sci. hungaricae*, 1956, Vol. 15, Nos. 1/2, pp. 191–204.

621.384.612 **3846**

Storage-Ring Synchrotron: Device for High-Energy Physics Research.—G. K. O'Neill. (*Phys. Rev.*, 1st June 1956, Vol. 102, No. 5, pp. 1418–1419.) Increased energy is made available, in an accelerator with a strong, well focused external beam, by means of two 'storage rings' comprising focusing magnets with straight sections built near the accelerator and operated at a high fixed field strength. Each ring contains a set of foils shaped so as to prevent the beams striking the inflectors.

621.385.83 : 621.386.1 **3847**

Electron Optics of X-Ray Tubes and the Design of Unbiased Sharply-Focusing Cathodes.—A. R. Lang & D. A. G. Broad. (*Brit. J. appl. Phys.*, June 1956, Vol. 7, No. 6, pp. 221–226.)

621.385.833 **3848**

Investigation of Nonrotationally Symmetrical Electrostatic Electron Optical Lenses.—R. F. Whitmer. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 808–815.) Analysis is presented for a two-cylinder lens.

621.385.833 **3849**

Practical Realization of a Magnetic Four-Pole Lens for Very-High-Frequency Particles.—A. Septier. (*C. R. Acad. Sci., Paris*, 9th July 1956, Vol. 243, No. 2, pp. 132–135.) A lens for focusing 50-MeV protons, with a focal length variable between 0·8 and 3 m, uses an electromagnet with four pole pieces formed by portions of circular cylinder.

621.387.4 : 621.374.32 **3850**

A Direct-Reading Counting-Rate Ratio Meter.—H. Miwa. (*J. phys. Soc. Japan*, April 1956, Vol. 11, No. 4, pp. 458–462.) A nonlogarithmic instrument for determining the ratio between two radiation-counting rates comprises a sawtooth voltage generator whose output is proportional to the period of one pulse train and is used to modulate the height of rectangular pulses synchronized with the second pulse train.

621.398 **3851**

Bandwidth Requirements of F.M./F.M. Telemetering.—J. C. Carpenter, Jr. (*Tele-Tech & Electronic Ind.*, May 1956, Vol. 15, No. 5, pp. 79 . . 147.)

621.385.833 **3852**

Handbuch der Physik, Band 33: Korpuskularoptik. [Book Review]—S. Flügge (Ed.). Publishers: Springer, Berlin, 1956, 702 pp., D.M. 122.50. (*Nature, Lond.*, 11th Aug. 1956, Vol. 178, No. 4528, pp. 285–286.) A comprehensive treatment of the optics of charged particles and of the electron microscope.

PROPAGATION OF WAVES

621.396.11 : 551.510.5 **3853**

Turbulent-Mixing Theory applied to Radio Scattering.—R. A. Silverman. (*J. appl. Phys.*, July 1956, Vol. 27, No. 7, pp. 699–705.) Scattering due to refractive-index fluctuations in the troposphere and ionosphere is discussed using statistical theory developed by Obukhov (1928 of 1949) and applied by Krasil'nikov (2024 of 1949). For the ionospheric case, the theoretical results are in order-of-magnitude agreement with the observed scattered power if the refractive-index fluctuations are attributed to electron-density fluctuations produced by turbulent mixing at the lower edge of the E layer. For the tropospheric case, order-of-magnitude agreement is obtained, except for the summer months, by attributing the refractive-index variations to temperature variations. Humidity and its fluctuations are important during the summer and at low scattering heights. The results are compared with those obtained by Villars & Weisskopf (244 of January).

621.396.11 : 551.510.535 **3854**

Ionospheric Prediction Methods and the Probable Sources of Error.—S. S. Baral. (*Indian J. Phys.*, April 1956, Vol. 30, No. 4, pp. 189–205.) Methods in current use for forecasting ionospheric characteristics are reviewed. An indication is given of the reduction of errors to be expected as greater accuracy is achieved in forecasting sunspot numbers and diurnal and seasonal variations, and in estimating geographical variations.

621.396.11 : 551.510.535 **3855**

Equatorial Ionospheric Absorption.—N. J. Skinner & R. W. Wright. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 103–117.) Vertical-incidence absorption measurements made at Ibadan during the period December 1953–December 1954 are studied. Nondeviative absorption appears to vary inversely with frequency; total absorption varies as $(\cos \chi)^n$, where χ is the sun's zenith distance and n is about 0·7. These variations are accounted for by assuming that the nondeviative absorption takes place in a Chapman-type D layer at a level where the electron collision frequency is of the same order as the angular frequency of the exploring signal. The frequency and seasonal variations at Singapore are similar to those at Ibadan.

621.396.11 : 551.510.535 : 537.533.1 **3856**

Theory of Nonlinear Effects in the Ionosphere.—S. A. Zhevakin & V. M. Fain. (*Zh. eksp. teor. Fiz.*, March 1956, Vol. 30, No. 3, pp. 518–527.) A theory of the Luxemburg and other nonlinear effects is developed on the basis of work noted in 79 of January (Fain). The self-demodulation effect [e.g. 1167 of 1954 (Cutolo)] could be utilized in an experimental determination of the effective electron-collision frequency.

621.396.11.029.51.08 **3857**

Low-Frequency Ground Waves. Equipment for the Measurement of the Phase Change with Distance.—G. E. Ashwell & C. S. Fowler. (*Wireless Engr*, Oct. 1956, Vol. 33, No. 10, pp. 245–250.) "The equipment described was developed to investigate the phase change with distance of a low-frequency wave passing over ground of finite conductivity and, in particular, the changes that occur near a boundary between grounds of different conductivities or across a coastline. The method employs a u.h.f. link between a fixed monitor station and a mobile measuring station to provide a reference signal against which the phase of the low-frequency signal is compared at the measuring station. The equipment is capable of operating over distances of up to 50 km and measures the phase to an accuracy of 2° at a frequency of 127·5 kc/s."

621.396.11.029.53/.55 : 523.78 **3858**

Sweep-Frequency Oblique-Incidence Experiments over a Distance of 1320 km.—H. G. Möller. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 155–156.) A preliminary note giving the main results of an investigation into the effects of the solar eclipse of 30th June 1954 on propagation between Lindau and Helsinki.

621.396.11.029.55 **3859**

An Estimate of the Size of the Antipodal Area in Short-Wave Radio Propagation.—H. A. Whale. (*J. atmos. terr. Phys.*, Aug./Sept. 1956, Vol. 9, Nos. 2/3, pp. 159–161.) From measurements made at Seagrove, Auckland, N.Z., of the elevation and bearing angles of arrival of transmissions on a frequency of 14·975 Mc/s from Slough, England, it is deduced that the antipodal area was about 550 km in radius, centred on the geometric antipodal point.

621.396.11.029.6 **3860**

Extended Transmission Ranges at Metre, Decimetre and Centimetre Wavelengths.—H. Poeverlein. (*Z. angew. Phys.*, May 1956, Vol. 8, No. 5, pp. 244–254.) A survey of typical modes of propagation giving rise to extended-range reception; over 60 references.

621.396.11.029.64 **3861**

Radio Transmission Experiments of Microwaves over the Sea.—M. Onoue, M. Nenohi, R. Usui & H. Irie. (*J. Radio Res. Labs, Japan*, April 1956, Vol. 3, No. 12, pp. 141–147.) Measurements of signal strength and direction of arrival for transmissions on a frequency of 9·375 kMc/s, over a distance of 77 km during the period September 1954–September 1955 are reported. Duct propagation is indicated.

621.396.11.029.65 : 535.343.4 **3862**

Measurement of Atmospheric Attenuation at Millimeter Wavelengths.—A. B. Crawford & D. C. Hogg. (*Bell Syst. tech. J.*, July 1956, Vol. 35, No. 4, pp. 907–916.) Technique is described in which a variable-frequency oscillation from a klystron generator is radiated from a horn aerial and reflected back by a pair of spaced corner reflectors whose relative reflecting properties are known. Absorption measurements in the wavelength range 5–6 mm are reported; the results are in good agreement with Van Vleck's theory of oxygen absorption (3098 of 1947).

621.396.812.3 : 551.510.535 **3863**

Study of the Selective Fading appearing on the *fct*-Traces.—H. Uyeda & Y. Nakata. (*J. Radio Res. Labs, Japan*, April 1956, Vol. 3, No. 12, pp. 119–133.) Records of the variation of critical frequency with time for the F_2 and E_s layers show evidence of selective fading caused by interference between waves reflected from the s...es of ripples in the layers. The mechanism of the fading and its bearing on layer structure are discussed.

RECEPTION

621.396.621 : 621.376.3 : 621.317.32 **3864**

Measurements of Interference Radiation from F.M. Receivers, carried out in Switzerland by a Group of Experts of the International Electrotechnical Commission Subcommittee 12-1 (Radio Communications—S.C. Measurements).—Meyer de Stadelhofen. (See 3826.)

621.396.621 : 621.376.33 **3865**

F.M. Receiver Design.—L. W. Johnson. (*Wireless World*, Oct. 1956, Vol. 62, No. 10, pp. 497–502.) Methods are reviewed for improving the capture ratio of f.m. receivers, with the object of overcoming multipath, co-channel and other types of interference. The bandwidth required in the circuits following the limiter depends on the desired capture ratio as well as on the frequency deviation. Principles developed at the Massachusetts Institute of Technology are explained and their application in receiver design is illustrated. Desirable characteristics can be obtained by use of wide-band modifications of the ratio detector in conjunction with preceding limiters. Use of the Type-6BN6 gated-beam valve simply as a limiter is recommended. Locked-oscillator and counter-type detectors are also discussed.

621.396.621.54 **3866**

Alignment Problems with Tuned Circuits in Superheterodyne Receivers.—W. Rotkiewicz. (*Hochfrequenztech. u. Elektroakust.*, April 1956, Vol. 64, No. 5, pp. 144–154.) Design formulae are derived for the r.f. and oscillator circuits. A method is developed in which the alignment errors are analysed first and the tuned circuits are then calculated. The interaction between a fixed-tuned primary and a variable-tuned secondary circuit is considered in relation to the alignment.

621.396.82 + 621.397.82 **3867**

Radio and Television Interference.—M. Smith. (*J. Brit. Instn Radio Engrs*, Aug. 1956, Vol. 16, No. 8, pp. 444–449. Discussion, pp. 449–452.) "A survey is given of the principle causes of interference to domestic radio and television; methods of detection and suppression of the various types of interference are also described, with particular reference to the work of the British Post Office investigating branch."

621.396.821 : 551.594.6 **3868**

The Level of Interference due to Atmospherics in the Very-Long-Wave Range, and its Diurnal and Seasonal Variations.—E. A. Lauter. (*Z. Met.*, April 1956, Vol. 10, No. 4, pp. 110–121.) Measurement procedure and definitions are discussed on the basis of observations of the frequency distribution of atmospherics at Kühlungsborn and the geographical distribution of the sources. Observations made over the period 1952–1954 on frequencies of 14, 27 and 48 kc/s are analysed and correlated with ionospheric propagation conditions. Results indicate that in winter the frequency dependence of the propagation conditions is the predominating influence on the diurnal variation of the atmospherics level, whereas in summer the approach of the disturbance centres is more important. Interdiurnal variations, twilight effect and solar-flare effect are mentioned briefly.

621.396.822 : 621.317.6 **3869**

Calculating Noise Level in Radar Receivers.—Haney. (See 3828.)

621.396.822 : 621.396.62 : 621.396.96 **3870**

Technical Possibilities for Noise Reduction in the Reception of Weak Radar Signals.—Borg. (See 3743.)

STATIONS AND COMMUNICATION SYSTEMS

621.39 : 534.7 **3871**

Speech Communication Research Symposium.—(See 3608.)

621.39 : 534.78 **3872**

The Intelligibility of Amplitude-Limited Speech.—Schneider. (See 3614.)

621.39 : 534.78 **3873**

A Development of the Collard Principle of Articulation Calculation.—D. L. Richards & R. B. Archbold. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 679–691.)

621.39 : 534.78 **3874**

Bandwidth and Channel Capacity Necessary to transmit the Formant Information of Speech.—J. L. Flanagan. (*J. acoust. Soc. Amer.*, Jr. 1956, Vol. 28, No. 4, pp. 592–596.)

621.39.001.11 **3875**

A New Interpretation of Information Rate.—J. L. Kelly, Jr. (*Bell Syst. tech. J.*, July 1956, Vol. 35, No. 4, pp. 917–926.)

621.39.001.11 **3876**

Interference Stability of Systems with Correcting Codes.—V. I. Siforov. (*Radiotekhnika i Elektronika*, Feb. 1956, Vol. 1, No. 2, pp. 131–142.) Relations are derived connecting the interference stability of communication systems with the parameters of the correcting codes used.

621.395.97 : 621.395.82 **3877**

The Influence of Long-Wave Transmissions on High-Frequency Diffusion of Programs on Overhead Telephone Lines.—R. Kallen. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st April 1956, Vol. 34, No. 4, pp. 145–157. In German.) An investigation was made of the possibility of improving signal/noise ratio while retaining the use of ordinary unstranded conductors. Both from theoretical considerations and from measurements, it appears that artificial balancing of the overhead lines would be ineffective. Arrangements for obtaining the best inherent symmetry are indicated.

621.396.41 : 621.376.55 **3878**

New Developments in Time-Sharing Multiplex Systems for Regional [radio] **Telephone Links.**—L. J. Libois. (*Électronique*, April 1956, No. 113, pp. 18–23.) For short-distance links, time-sharing systems with up to 24 channels are suitable. An a.m. carrier of 2 kMc/s or a f.m. carrier of 7 kMc/s is used in conjunction with p.p.m. The pulse waveform is symmetrical about zero, thus there is no d.c. component; this waveform is advantageous as regards signal/noise ratio. Appropriate transmitting and receiving equipment is outlined; a common aerial is used. The performance is adequate for transmission over some hundreds of km, using a number of sections. Systems of this type have been provisionally standardized by the C.C.I.R.; a link is installed between Bagnères-de-Bigorre and the Pic du Midi, about 15 km away.

621.396.65.029.62 : 621.396.41 **3879**

A Long-Distance V.H.F. Radio Link.—P. Brocklesby & P. Robinson. (*A.T.E. J.*, April 1956, Vol. 12, No. 2, pp. 78–88.) Four separate radio links on frequencies between 40 and 50 Mc/s are provided over a 200-mile path between the Shetlands and Norway, the path attenuation being 155 dB with 20 dB fading. Twelve f.m. carrier channels and four service channels are available, with a maximum modulation frequency of 12·2 kc/s.

621.396.712.3 : 534.86 **3880**

Modern Broadcasting Studios: Marseilles.—Pujolle. (See 3625.)

621.396.813 : 534.861 **3881**

The Receiving Side of a Radio Broadcast Transmission and its Influence on the Audio-Frequency Bandwidth.—W. Ebert. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, 1st April 1956, Vol. 34, No. 4, pp. 166–171. In German.) The effect of the different parts of the transmission chain on reproduction quality, previously discussed by Furrer et al. (1787 of 1949), is re-assessed in relation to f.m. v.h.f. systems. The loudspeaker still constitutes the most critical element from the point of view of bandwidth. It seems unlikely that any substantial improvement of quality would result if the a.f. transmission band were increased from 10 to 15 kc/s, except in the case of receivers equipped with suitable loudspeaker combinations.

621.396.93 : 621.396.6 **3882**

Generation of Transmission and Local-Oscillator Frequencies in [mobile] **Transmitters and Receivers.**—F. Läng. (*Bull. schweiz. elektrotech. Ver.*, 12th May 1956, Vol. 47, No. 10, pp. 458, 467–475.) Frequency-stability requirements are formulated on the basis of an examination of the effects of instability on signal/noise ratio and transmission quality. Only f.m. and ph.m. systems for the frequency band 30–500 Mc/s are considered. Methods of deriving the transmission frequency from quartz oscillators are outlined. Problems connected with channel switching and with the production of parasitic frequencies are discussed.

621.396.93.029.51 : 621.314.7 **3883**

Transistor-Operated Personnel Paging System.—(*Brit. Commun. Electronics*, May 1956, Vol. 3, No. 5, pp. 252–253.) The system comprises a 25-W transmitter, crystal-controlled on any one of up to 50 channels and feeding a loop surrounding the building, together with up to 50 pocket-size selective transistor receivers. The frequency band used is 75–87 kc/s; channel separation is 250 c/s. Apparatus serving a similar purpose is described in *Wireless World*, Nov. 1956, Vol. 62, No. 11, pp. 520–521.

621.396.931.029.62 **3884**

Mobile Radio Development.—J. R. Humphreys. (*Wireless World*, Oct. 1956, Vol. 62, No. 10, pp. 481–485.) The problem of channel congestion in the 71·5–88 and 156–184-Mc/s bands in the U.K. is reviewed with reference to the impending reduction of the upper limit to 174 Mc/s. Frequency stability, permitted power, geographical spacing of stations and the use of split channels are discussed in relation to equipment design for a suggested basic channel spacing of 25 kc/s.

621.396.933 **3885**

Symposium on Aeronautical Communications.—(*Trans. Inst. Radio Engrs*, May 1956, Vol. CS-4, No. 2, pp. 3–143.) The text is given of 17 papers presented at a symposium held at Utica, New York, in November 1955. Abstracts of most of these papers are given in *Proc. Inst. Radio Engrs*, July 1956, Vol. 44, No. 7, pp. 954–955.

SUBSIDIARY APPARATUS

621.311.6 : 537.311.33 : 535.215 **3886**

Theoretical Considerations governing the Choice of the Optimum Semiconductor for Photovoltaic Solar Energy Conversion.—Loferski. (See 3769.)

621.311.6 : 621.373.52 : 621.397.6 **3887**

C.R.T. Power Supply uses Transistor Oscillator.—P. M. Toscano & J. B. Heffner. (*Electronics*, Sept. 1956, Vol. 29, No. 9, pp. 162–165.) A 12·5-kc/s positive-feedback oscillator using a Ge transistor provides an output voltage which is doubled, rectified and stabilized at 10 kV. A collector supply of −30 V is the only external power required. For 1-mA output current the overall efficiency is 64%.

621.314.6 **3888**

Characteristics for Half-Wave Rectifier Circuits.—H. A. Enge. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 401–406.) "Voltage regulation characteristics, form factor, first harmonic, and peak current values are given for half wave rectifiers with common type loads. All in non-dimensional variables."

621.314.63 : 546.28 **3889**

Silicon Junction Power Diodes.—D. E. Mason, A. A. Shepherd & W. M. Walbank. (*J. Brit. Instn Radio Engrs*, Aug. 1956, Vol. 16, No. 8, pp. 431–441.) Simplified semiconductor theory is presented and a description is given of three main methods of making *p-n* junction diodes and of the properties of the diodes. Advantageous features and appropriate applications of these rectifiers are indicated.

621.316.722.1 : 621.311.6 **3890**

Wide-Range Voltage Stabilizers.—F. A. Benson & L. J. Bental. (*Electronic Engng*, Sept. 1956, Vol. 28, No. 343, pp. 390–394.) A unit is described, based on a circuit by Admiraal (863 of 1954), which gives a stabilized output voltage adjustable within the range 0–300 V, with maximum load current of 180–200 mA; the stabilization ratio is about 2 000.

TELEVISION AND PHOTOTELEGRAPHY

621.397.242 **3891**

The Broadcasting House/Crystal Palace Television Link.—A. R. A. Rendall & S. H. Padel. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 644–650. Discussion, pp. 663–666.) This 9-mile link uses two 0·975-in. coaxial cables and provides two

channels in each direction, only one of which is required initially. The system is d.s.b. a.m., and the carrier frequency is 15 Mc/s. The performance of the link is given in terms of the amplitude and differential-delay characteristics, transient response, linearity and signal/noise ratio.

621.397.6.001.4 : 621.317.74 **3892**

Portable Color-Signal Generator.—Popkin-Clurman. (See 3834.)

621.397.62 : 535.623 : 621.385.832 **3893**

The 'Apple' Television System.—(*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9.) Fuller details of the receiver described previously (3232 of October) are given in the following three papers:

A New Beam-Indexing Color-Television Display System.—R. G. Clapp, E. M. Creamer, S. W. Moulton, M. E. Partin & J. S. Bryan (pp. 1108–1114).

A Beam-Indexing Color Picture Tube—the Apple Tube.—G. F. Barnett, F. J. Bingley, S. L. Parsons, G. W. Pratt & M. Sadowsky (pp. 1115–1119).

Current Status of Apple Receiver Circuits and Components.—R. A. Bloomsburgh, W. P. Boothroyd, G. A. Fedde & R. C. Moore (pp. 1120–1124).

621.397.621.2 : 535.623 : 621.385.832 **3894**

An Analysis of Focusing and Deflection in the Post-Deflection-Focus Color Kinescope.—C. P. Carpenter, C. W. Helstrom & A. E. Anderson. (*Trans. Inst. Radio Engrs*, Oct. 1955, Vol. ED-2, No. 4, pp. 1–7.) Colour-television picture tubes are considered in which an array of parallel wires close to the phosphor screen is used for focusing the beam and for deflecting it up and down to produce the colour changes. Expressions are derived for the deflection sensitivity and the focusing properties; the variation over the grid plane is shown by contour maps. The theoretical results are supported by observations.

621.397.7 : 621.396.67.029.62 **3895**

The Crystal Palace Television Transmitting Station.—F. C. McLean, A. N. Thomas & R. A. Rowden. (*Proc. Instn elect. Engrs*, Part B, Sept. 1956, Vol. 103, No. 11, pp. 633–643. Discussion, pp. 663–666.) Factors underlying the siting, planning and design of the station are indicated and an account is given of steps taken to attain a high standard of reliability. The self-supporting aerial tower has a total height of 668 ft; the radiating elements are single dipoles for the upper half of the aerial and double dipoles for the lower half; aerial performance figures are given. For a shorter account see 2896 of September.

621.397.82 + 621.396.82 **3896**

Radio and Television Interference.—Smith. (See 3867.)

VALVES AND THERMIONICS

621.314.63 : 621.372.632 **3897**

Two-Terminal *P-N* Junction Devices for Frequency Conversion and Computation.—A. Uhlir, Jr. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1183–1191.) "Design principles for semiconductor diodes are derived from the analysis of idealized *p-n* junctions. The analysis gives the superheterodyne conversion matrix and the large-signal admittance in terms of the small-signal diffusion admittances. Structures that minimize minority-carrier storage give minimum conversion loss under matched conditions in converting a high frequency to a low frequency, and are useful in logic circuits of computers. Examples are the emitter-base diode of a transistor and a small bonded or point contact. Amplification and improved power-handling capabilities can be obtained in converting a low frequency to a high frequency, if the geometry favors storage of minority carriers near the junction. Such structures can also be used as pulse amplifiers."

621.314.7 : 546.28 : 621.375.4 **3898**

Micro-power Operation of Silicon Transistors.—E. Keonjian. (*Tele-Tech & Electronic Ind.*, May 1956, Vol. 15, No. 5, pp. 76–78 . . 142.) Characteristics are presented for Si transistors at power levels of a few μW over the temperature range $-25°$ to $+75°$C. An experimental two-stage audio amplifier is described having an output power of 10 μW, with overall gain of 37 dB within $\pm$ 3 dB over the range 20 c/s–20 kc/s; current consumption is 65 μA from a supply of 1·5 V.

621.314.7 : 621.318.57 **3899**

***P-N-P-N* Transistor Switches.**—J. L. Moll, M. Tanenbaum, J. M. Goldey & N. Holonyak. (*Proc. Inst. Radio Engrs*, Sept. 1956, Vol. 44, No. 9, pp. 1174–1182.) Discussion of the design, manufacture and electrical characteristics of Si transistors with $\alpha > 1$, for switching purposes. Over the high-impedance portion of the characteristic the impedance depends chiefly on the capacitance of the junctions, which is of the order of tens of pF. Over the low-impedance portion, the slope resistance is a few ohms. Suitable methods of manufacture include combinations of solid diffusion and alloying. Possible applications to function generators, relays, etc., are mentioned.

621.385.832 : 621.397.62 : 535.623 **3900**

The 'Apple' Television System.—(See 3893.)

621.385.832 : 621.397.621.2 : 535.623 **3901**

An Analysis of Focusing and Deflection in the Post-Deflection-Focus Color Kinescope.—Carpenter, Helstrom & Anderson. (See 3894.)

MISCELLANEOUS

621.3.049.75 **3902**

Printed Circuits.—(*Tele-Tech & Electronic Ind.*, Dec. 1955, Vol. 14, No. 12, pp. 68 . . 149.) This issue is a special one devoted largely to printed circuits; papers are given on the production of individual components and sub-assemblies, edge-dip soldering, assembly systems and special laminates; a directory of U.S.A. firms manufacturing printed circuits and related products is included.

ABSTRACTS AND REFERENCES INDEX

The Index to the Abstracts and References published throughout 1956 is in course of preparation and will be available with the March 1957 issue. Subscribers will receive the Index automatically. As usual, a selected list of the journals scanned for abstracting, with publishers' addresses, will be included.